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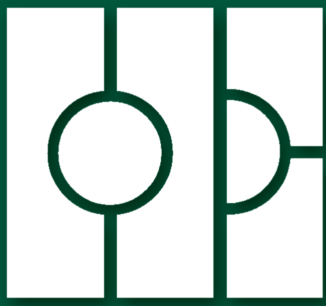

Official Journal of
AAHE
American Association for Health Education

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Foreword

A Call to Action for Diabetes Control

Griffin P. Rodgers

Pediatric and other health experts working with the National Diabetes Education Program (NDEP) are pleased to have been invited by the American Association for Health Education to create this contribution to the *American Journal of Health Education.* The eight articles contribute directly to initiatives that help fulfill NDEP's mission to reduce the morbidity and mortality associated with diabetes. NDEP is a federally funded program sponsored by the U.S. Department of Health and Human Services' National Institutes of Health and the Centers for Disease Control and Prevention and includes over 200 partners at the federal, state and local levels.

In 2007, about 186,300 young people under age 20 were reported to have type 1 or type 2 diabetes. Most have type 1 diabetes, but as obesity rates in children increase, type 2 diabetes—a disease that used to be seen primarily in adults over age 45—is becoming more common in young people. These young people and their families, as well as health care providers and health educators, face challenges when dealing with diabetes.

Articles in this issue of the *Journal* present practical evidence-based information to help health educators address the needs of youth at high risk for diabetes, as well as youth who have diabetes. These young people and their families need help to:

- develop healthy eating and physical activity habits
- utilize new diabetes management technologies
- cope with psychosocial stressors associated with diabetes management
- function fully and safely in all school activities
- access helpful community resources

Interventions from health educators will make a significant contribution to the health and well-being of young people with or at risk for diabetes. Our success in meeting the needs of these young people will also help ensure the health of future generations.

Griffin P. Rodgers is the director of the National Institute of Diabetes and Digestive and Kidney Diseases at the National Institutes of Health, Bethesda, MD.

Feature Article

Overview of Diabetes in Children and Teens

Francine R. Kaufman, Joanne M. Gallivan, and Elizabeth Warren-Boulton

ABSTRACT

Type 1 and type 2 diabetes affect about 186,000 youth under age 20. Previously considered an adult disease, type 2 diabetes is becoming increasingly common in overweight minority youth over 10 years of age. Criteria help to identify young people at risk for type 2 diabetes as well as those with the disease. Prevention or delay of type 2 requires weight loss through healthy eating, portion control and increased physical activity, along with family counseling and support. Type 1 diabetes usually has an acute onset and needs prompt diagnosis and treatment. It is important not to confuse its diagnosis with gastroenteritis. For both types of diabetes, management is determined by the family and diabetes care team depending on the child's type of diabetes and individual needs. Healthy eating and daily physical activity are key components. For those using glucose lowering medications, especially insulin (which is essential for type 1 diabetes), avoiding low blood glucose is important. Careful ongoing management of diabetes contributes to well-being and the avoidance or delay of onset of the long term diabetes complications. These complications affect normal function of the eyes, nerves, kidneys and cardiovascular system. Psychological support helps youth cope with the ongoing demands of diabetes management. Educators can help ensure the child's full participation in school activities.

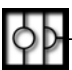
Kaufman FR, Gallivan JM, Warren-Boulton E. Overview of diabetes in children and teens. Am J Health Educ. *2009;40(5):259-263. This paper is part of a sponsored set of papers contributed through the National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health.*

STATISTICS – SCOPE OF THE DIABETES PROBLEM

Diabetes is one of the most common diseases in school-aged children. According to the National Diabetes Fact Sheet, approximately 186,300 youth in the U.S. under age 20 years had diabetes in 2007.[1] This figure represents 0.2% of all people in this age group. Based on data from 2002-2003, the SEARCH for Diabetes in Youth study reported that approximately 15,000 U.S. youth under 20 years of age are diagnosed annually with type 1 diabetes, and 3,700 are newly diagnosed with type 2 diabetes.[2] Type 2 diabetes is rare in children younger than 10 years of age, regardless of race or ethnicity. After 10 years of age, however, type 2 diabetes becomes increasingly common, especially in minority populations, representing 14.9% of newly diagnosed cases of diabetes in non-Hispanic whites, 46.1% in Hispanic youth, 57.8% in African Americans, 69.7 % in Asian/Pacific Islanders, and 86.2% in American Indian youth.[2]

Results from the 2005-2006 National Health and Nutrition Examination Survey (NHANES), using measured heights and weights, indicate that an estimated 16% to 17% of children and adolescents ages 2-19 years had a body mass index (BMI) greater than or equal to the 95th percentile of the age- and sex-specific BMI—about double the number two decades ago.[3] Overweight and obesity in youth contribute to increas-

Francine R. Kaufman is the chief medical officer and emeritus professor in the Keck School of Medicine, University of Southern California and at the Children's Hospital Los Angeles, Los Angeles, CA 90027; E-mail: fkaufman@chla.usc.edu. Joanne M. Gallivan is the director of the National Diabetes Education Program, National Institutes of Health, Bethesda, MD 20892; E-mail: joanne_gallivan@nih.gov. Elizabeth Warren-Boulton is a senior writer at Hager Sharp, Inc., Washington, D.C. 20008; E-mail: elizawb@gmail.com.



ing numbers of young people who have type 2 diabetes.

TYPES OF DIABETES

Diabetes mellitus is a group of diseases characterized by high levels of glucose in the blood resulting from defects in insulin production, insulin action, or both. Poorly managed diabetes is associated with serious complications (damage to the cardiovascular system, kidneys, eyes, nerves, blood vessels, skin, gums and teeth) and premature death. People with diabetes and their health care team can take steps to manage the disease effectively and lower the risk of complications.

Type 1 Diabetes

Type 1 diabetes is an autoimmune disease in which the immune system destroys the insulin-producing beta cells of the pancreas that help regulate blood glucose levels. The immunologic process that leads to type 1 diabetes can begin years before the symptoms of type 1 diabetes develop. Type 1 diabetes mostly has an acute onset, with children and adolescents usually able to pinpoint when symptoms began. Symptoms become apparent when most of the beta-cell population is destroyed. The peak age of the diagnosis of type 1 diabetes is 12 years. Early symptoms, mainly due to high blood glucose, include increased thirst and urination, constant hunger, weight loss and blurred vision. Children also may experience fatigue. As insulin deficiency worsens, ketoacids (formed from the breakdown of fat) build up in the blood and are excreted in the urine and breath. They cause shortness of breath and abdominal pain, vomiting and worsening dehydration. Elevation of blood glucose, acidosis and dehydration comprise the condition known as diabetic ketoacidosis, or DKA. If diabetes is not diagnosed and treated with insulin at this point, the individual can lapse into a life-threatening diabetic coma. It is not uncommon for children with vomiting to be mistakenly diagnosed as having gastroenteritis. New-onset cases of diabetes can be differentiated from gastrointestinal infections by the frequent urination that accompanies continued vomiting with diabetes.

Type 2 Diabetes

Often the first stage in the development of type 2 diabetes is insulin resistance, a condition requiring increasing amounts of insulin to be produced by the pancreas to control blood glucose levels. Initially, the pancreas responds by producing more insulin, but after some time, insulin production may decrease and diabetes develops. Type 2 diabetes used to occur mainly in adults who were overweight and older than 40 years. Now, as more children and adolescents in the U.S. become overweight, obese and inactive, type 2 diabetes rates are increasing, especially in children who have a family member with diabetes. Type 2 diabetes is more common in certain racial and ethnic groups such as African Americans, American Indians, Hispanic/Latino Americans and some Asian and Pacific Islander Americans. The increased incidence of type 2 diabetes in youth is a consequence of the obesity epidemic among young people, and is a significant and growing public health problem.[4]

Type 2 diabetes usually develops slowly and insidiously. Some youth with type 2 diabetes may show no symptoms at all when they are diagnosed, but in others, symptoms may be similar to those of type 1 diabetes:

- Feeling fatigued, thirsty, or nauseated
- Urinating often
- Experiencing weight loss, blurred vision, frequent infections, and slow healing of wounds or sores, vaginal yeast infection or burning on urination
- Experiencing severe dehydration and coma in those with extreme elevation of the blood glucose level

Conditions associated with insulin resistance include:

- Acanthosis nigricans, where the skin around the neck or in the armpits appears dark and thick, and has a velvety texture
- High blood pressure and lipid abnormalities
- Polycystic ovary syndrome in girls who have infrequent or absent periods, and excess hair and acne

Because children with type 2 diabetes are at risk for the long-term complications of diabetes and the co-morbidities associated with insulin resistance (lipid problems and high blood pressure), it is important that the health care team identify and test children or teens who are at high risk for type 2 diabetes.

Gestational Diabetes

Gestational diabetes mellitus (GDM) is a form of diabetes that is diagnosed in about 7% of all pregnancies; with an occurrence of about 200,000 per year.[5] It is more common among obese women, women with a family history of diabetes, and among African American, Hispanic/Latino American and American Indian women. During pregnancy, GDM must be treated to normalize maternal blood glucose levels and to avoid complications in the infant. GDM imparts a lifetime risk for type 2 diabetes to the mother, but the child also is at increased risk for obesity and diabetes compared to other children. The mother's GDM should be noted in the child's permanent medical record.

Pre-diabetes

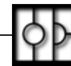
Pre-diabetes occurs when a person's blood glucose level is higher than normal but not high enough for a diagnosis of diabetes. It is important to assess high-risk youth for pre-diabetes or type 2 diabetes because timely diagnosis and treatment of type 2 diabetes can prevent or delay the onset of diabetes complications.

DIABETES SCREENING AND DIAGNOSIS

A pre-diabetes diagnosis occurs when a fasting plasma glucose level is 100 to 125 mg per dl (5.6 to 6.9 mmol per L). A diabetes diagnosis occurs when a fasting plasma glucose levels is 126 mg per dl (7.0 mmol per L) or greater. A second confirmatory test should be repeated on a subsequent day. Note that hemoglobin A1C, an estimate of the average blood glucose over the past 2-3 months, may be used to diagnose diabetes in the near future.

Screening Criteria[6]

Screening for the presence of type 2 diabetes should occur in children and youth who are overweight (BMI 85th to 94th per-



centile) or obese (BMI >95th percentile) for age and gender, whose weight for height is >85th percentile, or whose weight is >120% of ideal for height and who have any two of the following risk factors:

- Family history of type 2 diabetes in a first-degree or second-degree relative
- American Indian, African American, Hispanic/Latino, Asian American, or Pacific Islander heritage
- Signs of insulin resistance or conditions associated with insulin resistance (acanthosis nigricans, hypertension, dyslipidemia, polycystic ovarian syndrome)

Testing should begin at 10 years of age or at onset of puberty, if puberty occurs earlier than age 10. Testing frequency should be every two years. The screening test of choice is the fasting plasma glucose test. Clinical judgment should be used to perform testing in children and adolescents who do not meet the above criteria. The Centers for Disease Control and Prevention (CDC) BMI and growth curves can be used to calculate body fatness in children (http://www.cdc.gov/nccdphp/dnpa/bmi/index.htm).

TREATMENT STRATEGIES

There is no single diabetes management recipe that fits all youth. Blood glucose targets; frequency of blood glucose testing, type, dose and frequency of insulin; use of insulin injections with a syringe or a pen or pump; use of other injectable or oral glucose-lowering medication; and details of nutrition management vary among individuals. The family and diabetes care team determine the regimen that best suits each child's individual characteristics and circumstances.

The management of type 1 diabetes involves insulin therapy, nutrition management, physical activity, blood glucose testing and the avoidance of hypoglycemia. Insulin therapy is required for type 1 diabetes and algorithms are used for insulin dosing based on blood glucose level and food intake. Children receiving fixed insulin doses of intermediate-acting and rapid-acting insulins must have food given at the time of peak action of the insulin. Children receiving a long-acting basal insulin analogue or using an insulin pump receive a rapid-acting insulin analogue just before meals, with the amount of pre-meal insulin based on carbohydrate content of the meal using an insulin-to-carbohydrate ratio and a correction scale for hyperglycemia. Further adjustment of insulin or food intake may be made based on anticipation of special circumstances such as increased exercise and intercurrent illness. Children on these regimens are expected to check their blood glucose levels routinely before meals, after meals at bedtime, and occasionally, in the middle of the night. Blood glucose levels should be reassessed after an abnormally high or low glucose value to be sure that the corrective action taken normalized the glucose level.

The management of type 2 diabetes involves nutrition management with portion control, increased physical activity and blood glucose testing. If these actions are not sufficient to normalize blood glucose levels, glucose-lowering medications and/or insulin therapy are used as well. There are a variety of different diabetes medications, some that are taken orally and some taken by injection or pump, such as insulin. Youth with type 2 diabetes may take one or more different glucose-lowering medications. Glucose lowering medications differ by their mechanism of actions. The most frequently used oral glucose-lowering medication in children and adolescents is metformin. Glimperide is also approved for children who are ≥8 years of age.

It is important to counsel the child or teen with type 2 diabetes about healthy eating habits and the need for daily physical activity so that he or she can reach a healthy weight. Weight loss and physical activity independently increase the body's sensitivity to insulin.

For both types of diabetes, appropriate A1C, estimated average blood glucose (eAG), and daily glucose targets need to be determined by the child or teen and family with their health care team so that these can be met without excessive hypoglycemia. Note that most children younger than 6 or 7 years of age are unable to recognize or respond to symptoms of hypoglycemia.[2,6] Optimal A1C goal values for youth with type 1 diabetes are:

- Toddlers and preschoolers under age 6 – between 7 and 8.5
- Ages 6 to 12 -- < 8
- Adolescents and young adults ages 13 to 19 - < 7.5 (A goal of < 7.0 percent is reasonable if it can be achieved without excessive hypoglycemia)

Before meal and bedtime blood glucose goals can be found by consulting the American Diabetes Association 2009 Standards of Care.[6] These goals may be generally applicable to youth with type 2 diabetes.

Prevention or Delay of Type 2 Diabetes

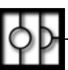
Prevention or delay of type 2 diabetes in children and at-risk teens requires health care professionals to educate, encourage and support the entire family to make lifestyle changes. Such lifestyle changes include incorporation of healthy eating habits and appropriate physical activity levels of 60 minutes per day.

MANAGEMENT OF HYPOGLYCEMIA

Diabetes treatment can sometimes cause blood glucose levels to drop too low, resulting in hypoglycemia (low blood glucose). Causes of hypoglycemia include taking too much insulin, missing a meal or snack, or engaging in strenuous exercise. Hypoglycemia also can occur when there is no apparent cause.

A child with hypoglycemia may become irritable, unstable, or confused. When blood glucose levels decline to very low levels, loss of consciousness or seizures may occur.

When hypoglycemia is recognized, the child should drink or eat a quick-acting sugar product equivalent to 15 grams of carbohydrate to quickly raise the blood glucose to greater than 70 mg/dl. Examples of 15 grams of carbohydrate are 3 or 4 glucose tablets or hard candies, 3 teaspoons (or three-fourths of a tube) of glucose gel, 4 ounces of juice, or 6 ounces (half a can) of non-diet soda. Once the blood glucose is over 70 mg/dl,



the child can eat food containing protein to maintain blood glucose levels in the target range. If the child is unable to eat or drink, a glucose gel may be administered to the buccal mucosa of the cheek; however, in the face of an altered level of consciousness or if the child cannot cooperate, glucagon or IV glucose should be administered. Hypoglycemia can be prevented by monitoring glucose levels regularly and before and after exercise, adjusting insulin dose and/or snacking before, during, or after vigorous activity, and at bedtime if blood glucose levels are below the bedtime target range.

MANAGEMENT OF HYPERGLYCEMIA

Causes of hyperglycemia (high blood glucose) include forgetting to take glucose lowering medications on time, eating too much, getting less physical activity than usual, or having an illness. Some episodes of hyperglycemia may occur without an apparent reason. A variety of medications used for other reasons can elevate the blood glucose, such as prednisone and other glucocorticoid compounds and psychotropic medications.

Sick day management rules, including assessment for ketosis with every illness, must be established for children with type 1 diabetes. Families need to be taught what to do for vomiting and for ketosis to prevent severe hyperglycemia and ketoacidosis.[7] Hyperglycemia can be prevented by monitoring glucose levels regularly, adjusting the insulin dose, adjusting the amount of food and/or amount of carbohydrate eaten and following sick day management rules.

MONITORING COMPLICATIONS AND REDUCING CVD RISK

Regular monitoring for the presence of diabetes complications allows for their early identification and the initiation of effective treatment. Early treatment can halt or delay the onset of disabilities associated with these complications. Detailed guidance on the prevention, screening and treatment of these complications in young people is available and is specific to type 1[6] and type 2 diabetes.[8]

Retinopathy (diabetes eye disease) most commonly occurs after the onset of puberty and after five to 10 years of diabetes duration, but it has been reported in prepubertal children and those with diabetes after only one to two years. Referrals for a dilated eye exam should be made to eye care professionals who have expertise in diabetic retinopathy, an understanding of the risk for retinopathy in the pediatric population, as well as experience in counseling the pediatric patient and family on the importance of early prevention/intervention.

To reduce the risk and/or slow the progression of *nephropathy* (diabetes kidney disease), regular screening is necessary for microalbuminuria, with a random spot urine sample analyzed for microalbumin-to-creatinine ratio. Optimal glucose and blood pressure management is essential.

Diabetes affects nerve functioning and may cause several conditions, including loss of sensation in the feet. Although it is unclear whether foot examinations are important in children and adolescents, annual foot examinations are painless, inexpensive, and provide an opportunity for education about foot care. The risk for foot complications is increased in people who have had diabetes over 10 years.

Because lipid abnormalities are associated with diabetes, regular assessment of a fasting lipid profile is necessary. Weight loss, increased physical activity and improvement in glycemic control often result in improvements in lipid levels. In people with diabetes, the goal for LDL-cholesterol is less than 100 mg/dl.

Careful control of hypertension in children is critical. Hypertension in childhood is defined as an average systolic or diastolic blood pressure >95th percentile for age, sex and height measured on at least three separate days. Normal blood pressure levels for age, sex and height, appropriate methods for measurement and treatment recommendations are available online at http://www.nhlbi.nih.gov/health/prof/heart/hbp/hbp_ped.pdf.

HELPING CHILDREN AND ADOLESCENTS MANAGE DIABETES

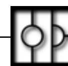
Diabetes management needs to address the physical and emotional growth needs of children, adolescents and their families, as well teens' emerging autonomy and independence. A health care team can address these issues and usually involves a physician, diabetes educator, dietitian and a social worker or psychologist. The team in partnership with the young person with diabetes and parents or other caregivers needs to develop a personal diabetes management plan and daily schedule. The plan helps the child or teen to follow a healthy meal plan, get regular physical activity, check blood glucose levels, take insulin or glucose lowering medication as prescribed and manage hyperglycemia and hypoglycemia.

A meal plan can help keep blood glucose levels in the target range, ensure proper nutrition for growth and energy, but reduce or prevent obesity. Families can learn how different types of food affect blood glucose levels, to measure portion sizes, select the right amount of calories and make healthy food choices. Family support for following the meal plan and setting up regular meal times is a key to success.

Children with diabetes need at least 60 minutes of physical activity each day, as do all children. Physical activity helps increase insulin sensitivity, lower blood glucose levels and maintains a healthy weight. The most common problem caused by physical activity is hypoglycemia in children taking insulin. It is important that blood glucose levels be checked before and after a game or sport and low values treated as necessary.

Young people with diabetes need to know the acceptable range for their blood glucose. Those using insulin need to check blood glucose values regularly with a meter and keep a record of the results to discuss with their health care team. The results help the team determine changes to the management plan. All diabetes medications need to be taken as prescribed.

Diabetes presents unique issues for young people with the disease. Self-care tasks need planning and carrying them out can make children feel "different" from their classmates. This type of "uniqueness" can be particularly bothersome or stigmatizing for teens. Learning to cope with diabetes



is a big task and may cause emotional and behavioral challenges, sometimes leading to depression. Talking to a social worker or psychologist may help young people and their families learn to adjust to the lifestyle changes needed to stay healthy and to find supportive help.

Whereas, all parents should talk to their children about avoiding tobacco, alcohol and other drugs, this dialogue is particularly important for children with diabetes. Smoking and diabetes independently increase the risk of cardiovascular disease, and people with diabetes who smoke have a greatly increased risk of heart disease and circulatory problems. Binge drinking can cause hyperglycemia acutely, followed by an increased risk of hypoglycemia. The symptoms of intoxication are similar to the symptoms of hypoglycemia, and thus, may result in delay of treatment of hypoglycemia, with potentially disastrous consequences.

Children with diabetes, depending on their age and level of maturity, will learn to take over much of their care. Most school-age children can recognize symptoms of hypoglycemia and monitor blood glucose levels. They also participate in nutrition decisions. They often can give their own insulin injections but may not be able to draw up the dose accurately in a syringe until ages 11 or 12 years. Adolescents often have the motor and cognitive skills to perform all diabetes-related self care, but because peer acceptance is important, risk-taking behaviors are common and rebellion against authority is part of a teens' search for independence. Thus, adolescents may need supervision in their diabetes tasks and be allowed gradual independence only if they maintain reasonable metabolic control.

In school, several federal and some state laws provide protections to children with disabilities, including diabetes. These laws help ensure that all students with diabetes are educated in a medically safe environment and have the same access to educational opportunities as their peers—in public and some private schools. A written plan that outlines the student's diabetes management helps the student, families, school staff and health care team to know what is expected of them. The school nurse is the most appropriate person to coordinate care for students with diabetes and to train, monitor and supervise school personnel.

Research is underway to find ways to prevent type 1 diabetes, to preserve beta cell function in people who have type 1 diabetes and to identify factors that trigger type 1 diabetes in susceptible individuals. New management strategies are helping children with type 1 diabetes live long and healthy lives. New research findings will help determine effective ways to lower risk factors for type 2 diabetes in high-risk children. Ongoing efforts to prevent and treat diabetes in children will require collaborative involvement of health care professionals, educators, schools, community institutions, and government agencies.

RESOURCES

National Diabetes Education Program (NDEP) Toll-free: 1-888-693-NDEP (6337). http://www.yourdiabetesinfo.org.

American Association of Diabetes Educators Toll-free: 800-TEAM-UP4 (1-800-832-6874). http://www.diabeteseducator.org.

American Diabetes Association Toll-free: 1-800-DIABETES (1-800-342-2383). http://www.diabetes.org.

Centers for Disease Control and Prevention Toll-free: 1-800-311-3435. http://www.cdc.gov.

Juvenile Diabetes Research Foundation International Toll-free: 1-800-223-1138. http://www.jdf.org.

Children with Diabetes Website. http://www.childrenwithdiabetes.com.

National Diabetes Information Clearinghouse Toll-free: 1-800-860-8747. http://www.niddk.nih.gov/health/diabetes/diabetes.htm.

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Feature Article

Role of Health Educators in Assisting Youth and Adolescents with Diabetes

Gail A. Spiegel, Alison Evert, and Laura Shea

ABSTRACT

Management of diabetes in children requires balancing nutrition, physical activity and medication on a daily basis in order to achieve blood glucose targets. The health educator can assist children and their families in meeting their diabetes management goals by better understanding the current recommendations and tasks involved to achieve them. Whereas children with type 1 diabetes require multiple injections of insulin per day or use of an insulin pump, children with type 2 diabetes may require an oral medication, insulin or both. Nutrition and physical activity recommendations are similar for children with diabetes as they are for all healthy children. Meal planning for children with diabetes usually involves a method of carbohydrate counting, since this is the main nutrient that raises blood glucose. Short term management outcomes for children with diabetes include the prevention of hypo- and hyperglycemia, while long term outcomes include the prevention of micro and macro-vascular complications.

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INTRODUCTION

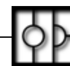
Children with diabetes need to balance food, medication and activity on a daily basis to keep their blood glucose in, or close to, a desired target range. This paper reviews current medication management, nutrition and physical activity recommendations for children with diabetes. Diabetes management outcome recommendations also are reviewed, along with ways that the health educator can assist children and their families to achieve their individualized nutrition, physical activity and diabetes management goals.

MEDICATION MANAGEMENT

All children with type 1 diabetes must take insulin for survival. Children with type 2 diabetes who require medication to control their blood glucose may take either an oral medication, insulin, or both. Today, new types of insulin and new delivery systems help to keep blood glucose levels in the desired range. These options, however, may require more frequent blood glucose monitoring and more assistance for the child with diabetes.

Insulin has three dimensions of importance to the successful management of diabetes: *onset*, the length of time before insulin

Gail A. Spiegel is a dietitian/certified diabetes instructor at the Barbara Davis Center for Childhood Diabetes, Aurora, CO 80045. Alison Evert is a diabetes nutrition educator in the University of Washington Medical Center, University of Washington, Seattle, WA 98105. Laura Shea is a public and professional education coordinator in the Diabetes Control and Prevention Program, New York State Department of Health, Albany, NY 12237; E-mail: las11@health.state.ny.us.



reaches the bloodstream and begins lowering blood glucose levels; *peak*, the time at which insulin is at its maximum strength in terms of lowering blood glucose levels; and, *duration*, the number of hours that insulin continues to lower blood glucose levels.

Most children with type 1 diabetes require multiple injections, or they receive their insulin through a programmable insulin pump. For children using injections, there are several types of insulin that may be used in combination. The different types of insulin have been formulated to have immediate (rapid-acting or short-acting insulin), intermediate, or long (basal insulin) onset and duration of action. A coordinated combination of different types of insulin is used to allow for adequate treatment of diabetes at meals, snacks, during periods of physical activity and throughout the night. For children using an insulin pump (a computerized device), a small amount of rapid or short-acting insulin is programmed to infuse 24 hours per day (basal rate) and additional doses (boluses) of rapid or short-acting insulin are programmed before eating meals and snacks or when high blood glucose levels are attained. By being aware of how medications play an important role in managing diabetes and the challenges that a child faces everyday, the health educator can help to provide a supportive atmosphere for the child to handle this complicated disease.

DIABETES NUTRITION RECOMMENDATIONS

The American Diabetes Association (ADA) states that nutrition recommendations for children and adolescents with diabetes should focus on achieving blood glucose goals (without excessive hypoglycemia), lipid and blood pressure goals and normal growth and development.[1] Today, meal plans for children with diabetes are individualized to accommodate food preferences, cultural influences, physical activity patterns and family eating patterns and schedules. Nutrient recommendations for children with diabetes are based on requirements for all healthy children and adolescents because there is little research on the nutrient requirements for children with diabetes.[1]

General nutrition recommendations from the United States Dietary Guidelines for Americans and the United States Department of Agriculture for all youth 4-18 year-olds include: 3 to 10 oz. of grains, 1 to 2.5 cups of fruit, 1.5 to 4 cups of vegetables, 3 to 7 oz. of lean meats and 2 to 3 cups of milk/dairy per day. Recommendations specify that at least half of all grains consumed should be whole grains, most dairy choices should be fat free or low fat, and vegetables and fruits with a rainbow of colors should be included.[2,3]

Total fat intake should be 25% to 35% of a child's calories per day, mostly from polyunsaturated and monounsaturated sources such as nuts, fish and vegetable oils. Less than 10% of calories should come from saturated fats (mostly found in animal products such as beef, cheese and butter) and trans-fatty acid (found in fried foods such as French fries and baked goods like crackers, cookies and other processed foods); consumption should be kept as low as possible. Sodium intake should be 1900-2300 milligrams per day or less (depending on age) to help prevent hypertension.[2]

Studies indicate that children and adolescents with diabetes fail to meet their nutrition goals. They are eating more total and saturated fat than recommended and many have inadequate intake of Vitamin E, fiber, fruits, vegetables and grains.[4,5] Encouraging children and families to meet dietary recommendations (increase fruit, vegetables, whole grains) and to decrease their intake of fats and sweets will help them stay at a healthy weight, and obtain the nutrients they need to achieve optimal growth.

The prevalence of childhood obesity is increasing rapidly worldwide, as is diabetes.[6] This phenomenon appears to be caused by a combination of over-nutrition and insufficient physical activity. For children with diabetes, other contributing factors may be over-insulinization, snacking and excess calorie intake to avoid or treat hypoglycemia.[7] In addition to the nutrition recommendations above, strategies to help children achieve and maintain a healthy weight include some of the following practices:

- Eat a healthy breakfast every day
- Eat low fat or fat free snacks such as fruit, vegetables, popcorn, or yogurt
- Decrease fast food visits
- When eating sweets, do so with a small serving at the end of a meal

DIABETES MEAL PLANNING APPROACHES

To achieve optimal blood glucose control, the American Diabetes Association recommends monitoring carbohydrates by carbohydrate counting, exchanges, or experience-based estimation as a key strategy.[8] Carbohydrate counting is the main form of meal planning prescribed for children with type 1 and type 2 diabetes. In the past, meal planning for diabetes was much less flexible, and children often were prescribed a rigid meal plan to match insulin dosing. Today, the prevailing approach is to match insulin to the child's nutrition (carbohydrate) intake. Because carbohydrate is the nutrient that the body converts to blood sugar, families of children with diabetes who take insulin are taught how to balance their insulin with the amount of total carbohydrates that their child is eating.

To count carbohydrates families first need to learn which foods contain carbohydrates. Sources of carbohydrate that convert to blood glucose include *starches* (grains, starchy vegetables, beans and lentils) and *sugars* (fruits, milk, yogurt and sweets). Fiber is also a type of carbohydrate that is an important part of any healthy food plan, but does not significantly contribute to blood glucose. Non-starchy vegetables such as broccoli and lettuce contain a small amount of carbohydrate, yet are typically an excellent source of dietary fiber. Whereas children with diabetes can eat foods that have added sugars, those foods should be included in moderation, as recommended for children without diabetes. Regular sodas, juices and other sugary drinks contain large amounts of carbohydrates, raise blood sugars quickly, are low in nutrition and are difficult to bal-

ance with insulin. Most diabetes health care professionals recommend that children with diabetes avoid these "liquid carbs," unless they are used to treat a low blood sugar.

There are two main methods of meal planning using carbohydrate counting: following a consistent carbohydrate meal plan or using an insulin-to-carbohydrate ratio to adjust insulin for variable carbohydrate intake. Which method a child uses will depend on the insulin regimen the child uses and the family's skill level. Many families start with a consistent carbohydrate meal plan.

On a consistent carbohydrate meal plan, the child with diabetes eats a set amount of carbohydrates at each meal and snack. This amount is individualized to the needs of the child. The amount of rapid acting insulin (meal insulin) that the child takes only changes for the blood glucose level. This method of carbohydrate counting often is used with children with type 1 diabetes who are on fixed dose regimens, or with children with type 2 diabetes who take only oral medication. With fixed-dose insulin regimens, it is important to maintain consistency in the timing and content of meals and snacks. The student should eat lunch at the same time each day. Snacks often are necessary and must be eaten to balance with the peak times of insulin action and with physical activity. Sample carbohydrate ranges for meals and snacks are listed in Table 1.[9]

Insulin-to-carbohydrate ratio, which is part of a basal-bolus regimen, is more physiologic and gives the child more lifestyle flexibility. These children will have an individualized insulin-to-carbohydrate ratio and blood glucose correction factor for dosing of their rapid-acting insulin. Basal-bolus insulin management includes giving multiple daily injections (MDI) of rapid acting insulin with a basal insulin, or using an insulin pump. The child's diabetes health care provider determines how much rapid-acting insulin the child needs to cover carbohydrates (insulin-to-carbohydrate ratio) and how much rapid-acting insulin he needs to lower blood glucose to the desired range (blood glucose correction factor). Insulin-to-carbohydrate ratios vary from child to child. For example, a five-year-old may use an insulin-to-carbohydrate ratio of 1 unit per 30 to 45 grams of carbohydrate, whereas teenagers may use 1 unit for each 7 to 15 grams of carbohydrate. Exhibit 1 contains a case study with a dosing calculation using an insulin-to-carbohydrate ratio and blood glucose correction. With MDI and pump therapy, children do not have to follow a fixed schedule for meals and snacks.

To count carbohydrate amounts accurately, children and their families are taught how to read the "Nutrition Facts" on food labels for total carbohydrate grams. Families should measure or weigh foods periodically to estimate portion sizes and carbohydrate content accurately. Families also should have a book or reference list that they can refer to for unlabeled foods. Many schools now are providing carbohydrate information for school lunch and breakfast, or it can be obtained through the food service director.

PHYSICAL ACTIVITY RECOMMENDATIONS

Children with diabetes are encouraged to participate in the same forms of physical activity as children without diabetes. Currently, it is recommended that children and adolescents participate in at least 60 minutes of moderate intensity physical activity most days of the week, preferably daily.[2] Children and adolescents with diabetes should stay active for many reasons: to maintain a healthy weight; feel stronger, healthier, and more positive about themselves; sleep better; and experience less stress.

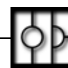
To ensure that children get the daily recommended amount of physical activity, the whole family is encouraged to participate. There are many activities that can be a part of spending time together as a family, even if members have different levels of expertise. For example, families can walk, hike, or bike together. Children can be taught to start out slowly and to advance to the full 60 minutes per day.

Physical activity should be enjoyable, and it is helpful to include children in planning the activity and where it takes place. If a child has a particular interest, he or she should be encouraged to pursue that interest. Being active does not have to be expensive. Activities such as playing tag, throwing a ball, jumping rope and walking are inexpensive ways to get kids moving.

Table 1. Meal Carbohydrate Amounts by Age

	Age: 5-12 years old	Age: Teens
Boys	45 to 60 grams of carbohydrate at each meal	60 to 75+ grams of carbohydrate at each meal
Girls	45 to 60 grams of carbohydrate at each meal	45 to 75 grams of carbohydrate at each meal

Carbohydrate amount must be individualized based on caloric needs, preferences, and activity levels. Snacks, if needed usually are 15 to 30 grams of carbohydrate. The child's diabetes health care provider helps to determine the amount of carbohydrate that is right for each child at each meal.



Many children spend much of their time watching television and playing video and computer games. The American Academy of Pediatrics recommends that children limit screen time to ≤2 hours per day.[10] Decreasing sedentary activities will lead to an increase in physical activity. Encouraging children to increase their daily activity level by taking the stairs instead of the elevator, walking the dog, or helping around the house also can help them to stay at a healthy weight.

Before starting a new program of physical activity, the child's parent or guardian should be instructed to check first with their diabetes health care provider. There may be adjustments to a child's meal plan and/or medications that need to be made to prevent hypoglycemia. Often it is recommended that the child's blood glucose level be monitored before, during, and after physical activity, especially when first beginning a program.

Exhibit 1. Case Study

Carlos is on MDI and he needs to calculate how much rapid acting insulin to take for his school lunch. Below are his dosing recommendations for carbohydrate intake and blood glucose, along with the carbohydrate content of his meal, pre-meal blood glucose level, and dosing calculations.

Recommended rapid-acting insulin dose:

Insulin- to-carbohydrate ratio = 1 unit of rapid acting insulin per 15 gm carbohydrate*
Blood glucose correction = 1 unit of rapid acting insulin per 50 mg/dl over 150 mg/dl blood glucose*

School Lunch	Carbohydrate Content
6 baked chicken nuggets	15 grams
½ cup mashed potatoes	15 grams
½ cup green beans	5 grams
½ cup canned fruit in natural juices	15 grams
1 carton 2% white milk	12 grams
Total	62 grams

Pre-meal Blood Glucose = 250
Total Carbohydrate Intake = 62 grams

Dosing Calculations:

Insulin needed for carbohydrates = 62÷15= 4
Insulin needed to lower blood glucose to target level= 250-150 (target) = 100 ÷ 50 = 2
Total Dose= 4 (Insulin needed for carbohydrates) + 2 (insulin needed for high blood glucose) = 6

* Insulin-to-carbohydrate ratios and blood glucose corrections are individualized for each child. This example should not be used as a recommendation for dosing.

SHORT-TERM DIABETES MANAGEMENT OUTCOMES—DAILY CHALLENGES

Hypoglycemia

In the 2005 position statement by the American Diabetes Association, near-normal glucose control was recommended for children with diabetes.[1] However, achieving optimal glycemic control is not without risks, the greatest being hypoglycemia (low blood glucose). On a daily basis, parents and caregivers must carefully balance their child's glycemic control with their child's unique vulnerability to hypoglycemia.[1]

Young children have difficulty recognizing hypoglycemia and as a result, parents and other caregivers, including school personnel, must be educated about signs and symptoms of this acute diabetes complication. To address these unique needs of the developing child, the ADA has developed age-specific glycemic goals that can be used together with the health care plan provided by the child's health care team[1] (Table 2).

Hypoglycemia usually can be treated easily and effectively. Early recognition of its symptoms and prompt treatment are necessary for preventing severely low blood glucose levels. Severe hypoglycemia that is not treated promptly can lead to unconsciousness and convulsions, which can be life threatening. One of the greatest frustrations for the child, caregiver, or school personnel can be the occurrence of hypoglycemia despite scrupulous efforts to maintain optimal glycemic control[13-15] (Table 3 and Table 4).

Hyperglycemia

Hyperglycemia, also called "high blood glucose," is a result of too little insulin or glucose-lowering medication, illness, infection, injury, emotional stress, ingestion of food that has not been covered by the appropriate amount of insulin, or decreased physical activity.

Symptoms of high blood glucose include increased thirst, frequent urination, nausea, blurry vision and fatigue. In the short term, hyperglycemia can impair cognitive abilities and affect academic performance. Over a long period of time, even moderately high blood glucose levels can lead to serious complications such as heart disease, stroke, blindness, kidney failure, and amputations.

Blood Glucose Self-Monitoring

Parents and caregivers can evaluate their child's blood glucose control by reviewing the daily blood glucose monitoring results on an ongoing basis. Weekly or periodic review of the child's blood glucose data can help the caregiver and the health care provider, including diabetes educators, to make treatment decisions. The child's individual response to their meal and snack choices, medication and physical activity

Table 2. Blood Glucose Goals for Children

Age	Before Meals	Bedtime Goal	HgbA1C
Toddlers and Preschoolers (< 6 years)	100-180 mg/dl	110-200 mg/dl	< 8.5 (but > 7.5)%
School-age (6-12 years)	90-180 mg/dl	100-180 mg/dl	< 8%
Adolescents and young adults (13-19 years)	90-130 mg/dl	90-150 mg/dl	< 7.5%

Source: American Diabetes Association: 2009 Clinical Practice Recommendations
Note: Individual goals may be different than the ones shown. Obtain specific guidelines from the child's diabetes health care provider.

Table 3. Management of Hypoglycemia

Teach causes of hypoglycemia:

- Eating too little or delaying a meal
- Diabetes medications
  - Insulin
  - Oral diabetes medications
- Unplanned or extra physical activity
- Unknown

Teach symptoms of hypoglycemia:

- Feeling shaky and/or sweaty
- Nausea
- Extreme hunger
- Heart pounding or racing
- Blurred vision
- Confusion and/or inability to concentrate
- Impaired judgment

Teach the "Rule of 15":

- If blood glucose level is:
  - Less than 70 mg/dl – treat with 15 grams of carbohydrate*
  - Less than 50 mg/dl – treat with 30 grams of carbohydrate
- Check again after 15 minutes
- If still less than 70 mg/dl, repeat treatment
- If next meal is not within 1 hour, eat a small snack with protein, such as cheese and crackers, or a small peanut butter sandwich

* See Table 4 for examples of 15 grams of carbohydrates.

can reveal an ongoing pattern of highs or lows. There are many reasons that blood glucose levels can vary, including inaccurate meal insulin dosing due to inaccurate carbohydrate counting. If results are not reviewed frequently, patterns are easily missed and opportunities for changes in diabetes medication and food plans are also missed.[1] Youth with diabetes should follow these guidelines for blood glucose self-monitoring:[1] use glucose levels to make insulin dose adjustments for rapid-acting or short-acting insulins and after observing patterns over several days to adjust doses of long-acting insulins; test at least four times a day; and periodically test two hours postprandial (i.e., after meals), before and after exercise and between 1:00 AM and 3:00 AM.

LONG-TERM OUTCOMES – REDUCING RISK OF COMPLICATIONS IN THE FUTURE

Hemoglobin A1C

Lowering hemoglobin A1C (HgbA1C) to an average of ~7% has been shown to reduce micro-vascular and neuropathic complications of diabetes and possibly macrovascular complications.[11] However, as stated previously, less stringent HgbA1C goals may be more appropriate for children due to their difficulty in being able to recognize the symptoms of hypoglycemia by themselves. The American Diabetes Association's 2008 standards of care recommend performing a HgbA1C quarterly with children.[11]

Growth

Medication and food plans for youth with diabetes must be updated continually. Growing children will need to have adjustments to therapy made from developmental and physical assessment data (height and weight plotted on a CDC growth chart), laboratory and blood glucose meter data, as well as lifestyle factors (changing food preferences, fluctuating levels of physical activity and school schedules).[1,12] Parents may restrict food at meal time or at snack time in an attempt to achieve desired glycemic targets, when all that is needed is an adjustment in oral diabetes medications or insulin doses. Insufficient caloric intake, as well as glucosuria, can impair the child's normal linear growth.

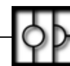


Table 4. Sources of Carbohydrates

Carbohydrate Source	Amount	Grams of carbohy-drate	Calories
Glucose Tablets 1 tablet = about 5 grams carbohydrate; check the label	3 to 4 tablets	15	60
Fruit Juice	½ cup	15	60
Soft Drinks (not diet or sugar free)	½ can	20	70
Sugar 1 teaspoon = 4 grams of carbohydrate	1 tbsp.	15	60
Sport Drinks	1 cup	15	60
Milk, Non-fat	1 cup	12	90
Milk, 1%	1 cup	12	105
Fruit Roll-Ups 1 roll = ½ ounce; check label	1	12 to 15	50 to 75
Raisins	2 tbsp.	15	60

Source: Evert AB, Hess-Fischl A. Pediat Diabet. Chicago, IL: American Dietetic Association; 2005.

Role of the Family: Transitioning Self-care Behaviors

Ongoing involvement of the family or caregiver is a crucial component in achieving optimal glycemic control. The level and amount of parental involvement will evolve as the child grows older.[1] Education and ongoing communication with all the individuals in the youth's life will help to carry out treatment plans in a successful and consistent manner. Diabetes medication and food plans must adapt to the growing child's needs.

SUMMARY

Whereas there have been many advances in diabetes management over recent years and children with diabetes have more flexibility in their lifestyle, eating schedules and nutrition intake, diabetes remains a complicated disease to manage. To achieve optimal blood glucose control, children with diabetes and their families need to be skilled at balancing medication, food and physical activity on a daily basis. By understanding the current guidelines and recommendations for nutrition, physical activity, and medication management, health educators can assist children and families better to achieve optimal blood glucose control in children with diabetes.

RESOURCES

Websites

CalorieKing Wellness Solutions. Available at http://www.calorieking.com (free nutrition information)

National Diabetes Education Program (NDEP). Available at: http://www.ndep.nih.gov/diabetes/youth/youth.htm (free resources)

Books

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Feature Article

Providing a Safe Environment for Students with Diabetes

Janet H. Silverstein, Crystal C. Jackson, Nichole Bobo, Francine R. Kaufman, Sarah Butler, and Katie Marschilok

ABSTRACT

Current diabetes regimens require more effort than ever before. The level of diabetes control students are able to maintain is affected greatly by their ability to care for their diabetes during the school day. This article reviews use of School Health Plans and Diabetes Medical Management Plans in schools. Students with diabetes, their families, health care providers and school personnel all have responsibilities that should be outlined in these plans. School nurses coordinate school-based diabetes care, provide training to school staff members, advocate for students and monitor implementation of students' school plans. Normal growth and development, prevention of complications and full participation in academic and social opportunities should be possible for students with diabetes. A variety of resources that support students with diabetes are described and referenced.

Silverstein JH, Jackson CC, Bobo N, Kaufman FR, Butler SS, Marschilok K. Providing a safe environment for students with diabetes. Am J Health Educ. *2009;40(5):271-275. This paper is part of a sponsored set of papers contributed through the National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health.*

INTRODUCTION

After the child's home, school represents the second most influential environment in a child's life.[1] Children with diabetes and their families are taught that optimal diabetes care involves frequent blood glucose monitoring, timing and monitoring of meals for carbohydrate content, and daily physical activity. All children with type 1 diabetes and some children with type 2 diabetes also require multiple daily injections of insulin by syringe, pen, insulin pump, or pod. It is essential that children with diabetes receive the needed support and assistance required to perform these tasks in the school setting with minimal disruption of their education. The goals of diabetes management in school are to optimize the educational experience of the student; promote normal growth, development and socialization; and prevent hypoglycemia, hyperglycemia and long-term complications.

Each child with diabetes is unique, and each child requires a Diabetes Medical Management Plan (DMMP) that is designed for his or her specific needs.[1] Whereas diabetes management for adults may be somewhat uniform, children are constantly changing and as they grow and enter puberty, the DMMP must be altered to address changes in blood glucose levels and pubertal insulin resistance. Responsibilities of the school are dependent upon the child's ability to perform diabetes self-management tasks. Insulin administration and blood glucose monitoring require certain psychomotor skills that may not be present in younger children. Understanding what to do with blood glucose levels requires cognitive skills, and young children or those with de-

Janet H. Silverstein is a professor and chief in the Pediatric Endocrinology Department, University of Florida, Gainesville, FL 32608; E-mail: silvejh@peds.ufl.edu. Crystal C. Jackson is the associate director Government Relations & Advocacy, American Diabetes Association, Alexandria, VA 22311; E-mail: cjackson@diabetes.org. Nichole Bobo is a Nursing Education director, National Association of School Nurses, Silver Spring, MD 20910; E-mail: nbobo@nasn.org. Francine R. Kaufman is the chief medical officer and Emeritus professor of Pediatrics, Keck School of Medicine, University of Southern California, Los Angeles, CA 90027; E-mail: fkaufman@chla.usc.edu. Sarah Butler is the Diabetes Education director, National Association of School Nurses, Silver Spring, MD 20910; E-mail: sbutler@nasn.org. Katie Marschilok is a clinical manager, Medtronic Diabetes, 4 Fairlawn Lane, Troy, NY 12180; E-mail: katie.k.marschilok@medtronic.com.

velopmental disabilities may not be able to determine appropriate treatment responses to blood glucose results. Varied levels of assistance are needed to ensure effective diabetes management for these children at school. These variables notwithstanding, all students with diabetes require assistance when they are experiencing moderate to severe hypoglycemia. Assistance may include the administration of glucagon. The needs of students with diabetes must be met in the school setting to meet federal law requirements and to ensure the safety of the student with diabetes.[2]

The child's personal diabetes health care team (physician, diabetes educator, dietitian and social worker, or psychologist) with input from the parent or guardian, develops the DMMP.[3] Implementation of the child's DMMP at school requires communication among a number of key individuals who collectively comprise the school health care team (the student, student's family, school nurse and other health personnel, trained non-medical personnel, school administrator or principal, the student's teacher(s), the guidance counselor and other relevant staff). To provide a supportive school environment, it is important that team members understand their roles in managing the child with diabetes. A safe school environment requires participation of all school personnel, with special training given to those with whom the child has contact.

This paper is based on the National Diabetes Education Program (NDEP) publication "Helping the Child with Diabetes Succeed: A Guide for School Personnel." It can be accessed at: http://ndep.nih.gov/media/Youth_NDEPSchoolGuide.pdf

TREATMENT

Multiple advances over the past decade have revolutionized treatment of diabetes in youth. Evidence suggests that frequent blood glucose monitoring and insulin administration three or more times a day can result in improved blood glucose control and decreased rate of complications of diabetes.[4,5] As a result, there is a proliferation of new insulins, blood glucose monitoring technologies and insulin delivery systems that enable diabetes management to be optimized and intensified. Thus, the main goal of treatment is to achieve and maintain blood glucose levels as close to normal as is safely possible. To achieve this goal, insulin therapy must be customized to fit the child's preferred lifestyle. Most diabetes care providers now instruct patients to follow flexible eating patterns and activity and to adjust their insulin doses accordingly, rather than asking patients to adhere to a rigid meal plan and insulin dose, as had previously been prescribed.

As diabetes management technology has progressed, enabling new tools for improved diabetes management, schools are being asked now to perform more diabetes related tasks than in the past. For example, only a decade ago, most children were not on a basal-bolus regimen. With the current widespread use of basal-bolus regimens supervision of insulin administration, and sometimes the actual performance of the care task by the school nurse or another trained school staff member, is needed. _Based on the student's level of skill and maturity, a child may need help with checking blood glucose levels, giving insulin and determining the insulin dose based on the child's carbohydrate ratio in order to determine food eaten and the correction factor to cover high blood glucose concentrations. School personnel must have the information they need to recognize signs of hypoglycemia and hyperglycemia and to be knowledgeable about how to manage blood glucose levels outside the child's target range, including how to give an injection of glucagon if the child is hypoglycemic and unable to take glucose by mouth.

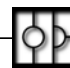
The school nurse is responsible for coordinating school-based diabetes care. The school nurse has the skills, knowledge base and statutory authority to meet the health care needs of the student. However, not every school has a full time nurse, and, even for those schools with nurses, the nurses may be sick, on vacation, or attending to another emergency. Their work day rarely includes after-school hours, when the student participates in extra-curricular activities. There needs to be trained and knowledgeable individuals who can meet the child's diabetes health care needs during the entire school day and all school-sponsored activities, including before and after school events. Non-medical personnel should be trained to perform diabetes care tasks when a school nurse is not present.

SCHOOL HEALTH PLANS

Written plans that outline each student's diabetes health care needs are essential to facilitate a safe environment in school for the student with diabetes. Written plans become the communication tool used among students, their families, the school health care team and the student's personal diabetes health care team so that each individual knows what is expected. These expectations should be outlined in writing in several documents as outlined below.

The *Diabetes Medical Management Plan* (DMMP), developed by the student's personal diabetes health care team, contains the prescribed diabetes care regimen, tailored for each student. The DMMP contains medical orders developed by the student's personal diabetes health care team and should be signed by the student's health care provider. Information in the DMMP may include the following:

- Date of diagnosis
- Specific medical orders
- Emergency contact information
- 72-hour disaster or emergency plan
- Student's willingness and ability to perform self-management tasks at school
- List of diabetes equipment and supplies
- Frequency of blood glucose monitoring
- Insulin, glucagons and other medications to be given at school
- Meal and snack plan
- Exercise requirements
- Specific signs, symptoms and prescribed treatment for hypoglycemia
- Specific signs, symptoms and prescribed treatment for hyperglycemia



The *Quick Reference Diabetes Emergency Plan* is based on the medical orders in the student's DMMP and developed by the school nurse. This plan describes how to recognize and treat hypoglycemia and hyperglycemia and should be distributed to all school personnel who have responsibility for students with diabetes.

The *Individualized Health Care Plan* (IHP), based on the medical orders found within the DMMP and developed by the school nurse, outlines individualized diabetes management strategies for implementing the student's DMMP in the school setting. The IHP incorporates an assessment of the school environment as well as student-specific information (familial, psychosocial and developmental information). School nurses use the information from the DMMP and additional assessment findings to outline diabetes management strategies and personnel needed at school to meet the student's health goals as outlined in the DMMP. The IHP is reviewed with the student and family before it is implemented. Establishing a timeline to revisit the plan periodically to evaluate progress toward desired health goals throughout the school year is essential for ensuring the student's safety, well-being and academic success. Information in the IHP may include:

• Plan to maintain blood glucose within the range ordered by the healthcare provider

• Guidelines for communicating with the family and healthcare provider

• List of trained diabetes personnel and the diabetes care tasks they will perform

• Timeline for supervision of trained diabetes personnel

• Routine for monitoring blood glucose (where to check, how often, where supplies should be kept)

• Time frame for ongoing review of student outcomes

• Strategies to ensure that the student avoids inappropriate penalties for health appointments and illness, and receives accommodations during the school day

• Plans to educate school personnel (substitute teachers, bus drivers, physical education instructors, cafeteria personnel)

• Plan for the student who independently manages at school

Education plans, such as the Section 504 Plan (504 Plan) developed pursuant to Section 504 of the Rehabilitation Act of 1973 or the Individualized Education Program (IEP), developed under the Individuals with Disabilities Education Act protect students with disabilities. These plans are developed in collaboration with the school health care team and lay out the health care-related aids, services and accommodations as well as any special education services the student may need as the school year unfolds. The 504 Plan, IEP, or other written education plan, should include at least:

• Where and when blood glucose monitoring and treatment will take place

• When and where insulin will be administered

• Identification of school personnel who are trained to monitor blood glucose, administer insulin and glucagon, and treat hypoglycemia and hyperglycemia

• Who has primary responsibility for the student's diabetes care during the school day and during school sponsored events that take place before, after school, or on weekends

• Location of the student's diabetes management supplies

• Free access to the restroom and water

• Nutritional needs, including provisions for meals and snacks

• Full participation in all school-sponsored activities and field trips, with coverage provided by trained diabetes personnel

• Alternative times and arrangements for academic exams if the student is experiencing hypoglycemia or hyperglycemia

• Permission for absences, without penalty, for health care appointments and prolonged illness

• Maintenance of confidentiality and the student's right to privacy

RESPONSIBILITIES OF THE CHILD, FAMILY, SCHOOL PERSONNEL AND PRINCIPAL

Child

Responsibilities of the student depend on the age of the child. The child in elementary school may not be able to check blood glucose levels independently and will always need to be supervised. Many students in middle school and high school, on the other hand, may be responsible and knowledgeable about their diabetes care and may be able to perform blood glucose checks independently. In general, older students, because of their greater maturity and skill, may be fully in charge of their own insulin administration at school. Older students should know when to check blood glucose levels and when to eat meals and administer insulin at appropriately scheduled times. All students who are self-managing their insulin injections and blood glucose monitoring should be responsible for discarding lancets, needles and other supplies used for insulin administration and blood glucose monitoring appropriately.

Family

The parent or guardian of the child with diabetes is responsible for providing the DMMP to the school nurse and for meeting with the school health care team to participate in development and implementation of the IHP. Family participation in an annual 504 or IEP meeting will clarify both family and school expectations with regard to the student's diabetes management, including a thorough discussion about scheduled insulin administration, indications for giving additional insulin, and glucose monitoring.

The family is responsible for providing and maintaining all diabetes supplies at school for the child and should make sure that all needs are met during school-related activities. The storage location for all necessary diabetes supplies should be clearly stated. Other parent or guardian responsibilities include: providing signed permission for school personnel and the child's personal diabetes health care team in order to share information regarding the student's diabe-

tes; providing and maintaining all diabetes supplies; and informing the school of any changes in the child's DMMP.

Food service personnel should provide the parent or guardian with the carbohydrate content of the foods served in the cafeteria, and the parent or guardian should discuss with the school nurse the importance of correct insulin dosing as directed by the DMMP. If children bring their lunch to school, the parent or guardian should provide the carbohydrate content for these foods to the school nurse to allow accurate insulin dosing.

SCHOOL PERSONNEL

Three levels of training are needed to keep students with diabetes safe at school. *Level 1* training is for all school staff members and teaches everyone how to recognize hypoglycemia and hyperglycemia and who to contact for help. *Level 2* training builds on *Level 1* and is designed for all school staff members who have responsibility for the student with diabetes throughout the school day, providing them with additional understanding about diabetes and its impact upon the student. Specific instruction on the student's Quick Reference Diabetes Emergency Plan must be included. Finally, *Level 3* training is for any school staff members designated as trained diabetes personnel by the school nurse, or other qualified health care professional, who will perform or assist a student with diabetes care tasks, that often include blood glucose monitoring and insulin and glucagon administration.

Principal

The school principal is responsible for making certain that school personnel understand and comply with federal and state laws that may apply to students with diabetes, including Section 504 of the Rehabilitation Act of 1973, the Americans with Disabilities Act and the Individuals with Disabilities Education Act.

ROLE OF THE SCHOOL NURSE

The school nurse is the health professional who has responsibility for assuring that children with diabetes receive diabetes care according to the DMMP formulated by the student's personal diabetes health care team. To perform the DMMP successfully, the nurse must obtain and review the student's current DMMP and pertinent information from the family. Based on this information and other information gathered by the school nurse, the IHP is developed. Once approved and implemented, the IHP must be reviewed and updated throughout the school year. The school nurse also is responsible for coordinating development of a *Quick Reference Diabetes Emergency Plan* based on the DMMP and for providing copies of this plan to staff members who have responsibility for the student throughout the school day (e.g., teachers, coach, physical education teacher, lunchroom staff and bus driver). For those students with diabetes who also qualify for a 504 plan or IEP, it is critical that the school nurse participate in development and ongoing supervision of these plans.

All diabetes care tasks outlined in the student's DMMP must be provided at school. The amount of direct care provided by the school nurse in implementing these tasks will vary depending on individual needs of the child and availability of the school nurse. In addition, accurate and confidential documentation is required, as well as ongoing supervision and evaluation of the student.

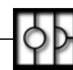
When available, the school nurse is the most appropriate person to implement the student's written plans. When a school nurse is not readily available, the diabetes medical community has found that under supervision non-medical personnel, sometimes called "trained diabetes personnel," can be available to perform diabetes care tasks safely in the school setting. This position is trained and supervised by the school nurse and can be held by any school staff member, including teachers, health aides and school office personnel.

Diabetes care tasks may include blood glucose monitoring, insulin and glucagon administration, and urine or blood testing for ketones. Whereas requirements of federal laws must be met, assignment of diabetes care tasks by the school nurse or other health care professional must take into account state laws that may be relevant in determining which tasks are performed by trained diabetes personnel.

As the student's advocate, and with permission of the student's personal health care team and parent or guardian, the school nurse is expected to encourage independence with all diabetes care tasks at school, consistent with the student's level of maturity and skill. The school nurse role is imperative in reaching the goals of providing a student with an optimal educational experience, promoting normal growth and development, and preventing hypoglycemia, hyperglycemia, and long term complications of diabetes.

SUMMARY

Goals for effective diabetes management at school are shared by many individuals. These goals include providing a positive school experience, promoting full participation at school, supporting normal growth and development, reducing risk of diabetes related emergencies and the long-term risks of diabetes, and ensuring that students are safe and ready to learn.[2,6,7] Many resources exist to assist in meeting these goals. The National Diabetes Education Program's School Guide, *Helping the Student with Diabetes Succeed*,[8] provides tools and guidance to help schools ensure the child with diabetes is medically safe and ready to learn. The American Diabetes Association has multiple resources available from their website, including a sample DMMP and 504 plan, and training materials for school personnel titled *Diabetes Care Tasks at School: What Key Personnel Need to Know.* The National Association of School Nurses offers a live continuing education program for school nurses called H.A.N.D.S.℠, (Helping Administer to the Needs of the Student with Diabetes in School) where school nurses receive current diabetes management information as well as forms and tools to develop and implement diabetes plans in the school setting. A collaborative relationship between the family, the school health care team and



the child's personal diabetes team is the key to a safe and successful educational experience for the child.

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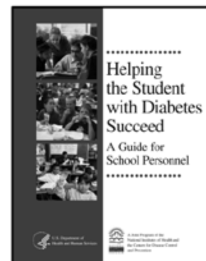
The National Diabetes Education Program Offers Free Resources for Health Educators

Helping the Student with Diabetes Succeed: A Guide for School Personnel

This comprehensive guide is a useful resource to ensure effective diabetes management in school settings.

- Copier-ready action plans
- Diabetes primer
- Review of school responsibilities under federal laws



Move It! And Reduce Your Risk of Diabetes School Kit

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Research Article

Psychosocial Issues that Affect Youth with Diabetes

Christina Cammarata, Kara J. Meyer, Gary Geffken, Dania Felipe, Diane Franz, Alfonso Vargas, and Jodi L. Kamps

ABSTRACT

Type 1 diabetes, one of the most common diseases of childhood, requires adherence to a complicated regimen which is often times difficult to manage resulting in stress for children, siblings, and caregivers. Many children with diabetes are nonadherent, likely due to the difficulty and complexity of the tasks required, and, thus, are at greater risk for diabetes related complications. For health care educators, it is important to understand the various psychosocial issues that affect adherence and adjustment to diabetes. This article will discuss these issues, including coping with a new diagnosis, school factors, regimen adherence and family variable and parenting strategies. Recommendations for health care educators are also discussed.

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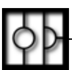
INTRODUCTION

Type 1 diabetes (T1D) is a difficult and taxing disease for children and adolescents. It requires the family to balance challenging medical tasks (e.g., blood glucose monitoring, multiple daily insulin injections, dose calculations, advanced level of problem solving or decision making) with dietary modification and exercise into already complex daily lives to maintain stable blood glucose levels to prevent complications to growth and development. Considering the level of difficulty, it is not surprising that 50% to 55% of youth are nonadherent and as many as 30% to 50% of youth with T1D are in poor glycemic control.[1] As a result, these children face severe health complications such as increased risk for diabetic ketoacidosis (DKA), damage to major organ systems and premature death.[1-3] In addition to the direct consequences, nonadherence may impact clinical decisions made by health care pro-

Christina Cammarata is a post doctoral associate in the Department of Psychiatry/Department of Pediatrics, PO Box 100234, University of Florida, Gainesville Florida 32610; E-mail: ccamma@ufl.edu. Kara J. Meyer is a postdoctoral associate in the Department of Psychiatry, PO Box 100234, University of Florida, Gainesville Florida 32610; E-mail: kmeyer@ufl.edu. Gary Geffken is an associate professor in the Department of Pediatrics, PO Box 100234, University of Florida, Gainesville Florida 32610; E-mail: geffken@ufl.edu. Dania Felipe is a senior fellow in the Department of Pediatrics - Division of Endocrinology, Louisiana State University Health Sciences Center Children's Hospital, New Orleans, LA 70118; E-mail: dfelip@lsuhsc.edu. Diane Franz is a licensed clinical psychologist, Children's Hosptial of New Orleans, Department of Psychology; E-mail: dfranz@chnola.org. Alfonso Vargas is a professor and vice-chairman for Education and International Affairs Department of Pediatrics/Division of Endocrinology Louisiana State University Health Sciences Center Children's Hospital, Louisiana State University, New Orleans, LA 70118; E-mail: avarga@lsuhsc.edu. Jodi L. Kamps is a licensed clinical psychologist, Children's Hosptial of New Orleans, Department of Psychology; E-mail: jkamps@chnola.org.



viders, such as increasing insulin doses for high blood glucose levels when, in fact, high glucose concentrations are due to failure to follow the diabetes regimen. Further, poor adherence results in medication abuse and excessive use of health care services.[4, 5]

Understanding factors associated with adjustment and adherence is important for anyone working with children and adolescents with diabetes, as better adherence may translate to improved glycemic control.[6] Adherence to the diabetes regimen is influenced by many factors, such as initial adjustment and acceptance of the illness as well as coping with behavioral, school and family stressors. Given the severity of complications resulting from poor glycemic control, health educators must be knowledgeable about these various psychosocial factors in order to help identify youth at risk for poor adjustment to their diabetes and to guide strategies aimed at improving regimen adherence.

COPING WITH A NEW DIAGNOSIS

Diabetes is one of the most common chronic illnesses of childhood with more than 13,000 new diagnoses occurring each year.[7] A diagnosis of type 1 diabetes elicits a number of emotions and grief reactions including anger, sadness, guilt and anxiety which typically resolve within the first year.[8] Psychosocial acceptance and adaptation to the illness can impact long term adjustment for both children with diabetes and their families.

When a child is diagnosed with diabetes, parents must learn a large amount of new information and many new skills to care for their child adequately, while experiencing a wide range of emotions, including shock, grief and guilt. Parents often attempt to cope with the diagnosis using a variety of strategies that may be helpful or may interfere with the child's ability to cope.[9] Some parents have difficulty accepting the information and cope by denying that their lives will change or that diabetes will affect them.[10] Other parents respond with anxiety and attempt to control more aspects of the child's life. After time, parents may find a healthy balance between being involved in their child's care and allowing freedom to be a child. It is important to help parents to establish realistic expectations about management of diabetes, financial costs, reasonable glycemic control and methods for treating hypoglycemia.

Children experience a number of emotions after learning they have diabetes, including anxiety, depression, and social withdrawal.[9,10] Most children return to baseline within seven to nine months, however a number of children experience long-term adjustment difficulties.[11, 12] Poorer health is associated with poorer adjustment.[13] Children entering middle childhood and adolescents face difficult social challenges in terms of developing their independence and unique identities, and developing peer relationships.[9] Diabetes may complicate many of these issues due to fear of stigmatization from peers, teasing from peers and heightened awareness of differences and sense of inadequacy. These events may impact self-esteem which is associated with poorer control.[14]

DIABETES AND THE SCHOOL SETTING

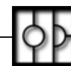
Children with chronic diseases tend to be absent from school more often.[15] Reasons can include poor health, physician appointments and school refusal. Children with diabetes who are in poor control are particularly at risk as they experience more hospitalizations and physical complaints. Further, parents may experience anxiety about sending their children to school for fear that staff members are not as capable of caring for a child with diabetes. Children are more likely to have feelings of separation anxiety due to heavy reliance on parental care. Children who fear stigmatization or teasing may develop school phobias and avoidance. Also, children may learn to use high and low blood sugar episodes as means of avoiding aversive or unpleasant tasks, such as taking tests or attending particular classes.

Children with diabetes typically demonstrate average cognitive abilities but may experience some mild learning or neuropsychological deficits subsequent to their illness. Some mild deficits in verbal intelligence, attention, memory and executive functioning have been noted, especially in children diagnosed under the age of four who have experienced many hypoglycemic episodes.[16] These factors are particularly relevant as they impact the ability of children to successfully manage their own health care. Adolescents with decreased executive functioning will not be able to plan and organize their own health behaviors adequately, and will, therefore, have poorer adherence once responsibility for diabetes care shifts from the parent to child.[14]

It is important to establish and maintain frequent contact with school staff members to maximize school success. Information should be shared about out of range blood sugars, regimen details and treatment responses. Staff members should be knowledgeable about the need for snacks during physical activities, the need to check blood sugars at appropriate times and the need for administration of insulin and meals at scheduled intervals. Children should be encouraged to participate fully in all activities to minimize the perception of differences between the child and his or her peers.[17]

ADHERENCE TO THE REGIMEN

Adherence and control describe two different aspects of diabetes management. Whereas adherence refers to the degree to which the child is completing health-related behaviors as prescribed by the physician, control refers to the metabolic status reflecting the degree to which blood glucose levels are in the normal range.[14] Children may be relatively compliant and still exhibit poor control. Furthermore, children will typically demonstrate adherence to one or more aspects of their diabetes care while being noncompliant with others. Parents should be encouraged to participate in their child's diabetes management to the degree necessary for the child to succeed with disease management. Health care professionals may be helpful in establishing concrete strategies for children and their parents to use to establish better control.[17] For example, by setting small, specific, manageable and



realistic goals that they can work toward, the family will experience greater feelings of efficacy over their management of the illness. Assessing the family's motivation for change can provide valuable information about how to approach goal setting in children experiencing management difficulties.[18, 19] Some families may feel overwhelmed and, therefore, avoid change. These families will require considerable support before moving into a more action focused phase.[18] Several assessment strategies are helpful such as self-report and observational health measures, physician ratings, behavioral observation of health behaviors and 24-hour recall interviews.[14] It is also important to assess the diabetes-related knowledge levels and general problem solving skills to identify any deficits that may lead to inadvertent non-adherence.[14]

Children may display maladaptive behaviors that adversely affect adherence.[14] When children have poorly controlled blood sugar levels it is helpful to assess if they are skipping insulin injections or administering excess insulin. Because insulin is necessary for weight gain and development, the side effect of too little insulin includes weight loss in addition to hyperglycemia. Failure to administer insulin injections, resulting in recurrent hospitalizations for DKA may be a cry for help or a marker of depression or suicidal ideation. Finally, there is an increased prevalence of eating disorders in children with diabetes, as habitual dietary restraint can lead to binge eating, and these children must, therefore, be monitored for bulimia and other eating disorders.[20] Moreover, fear of hypoglycemia and fear of embarrassment if seizure occurs or a child or adolescent passes out in front of peers is a major barrier to good glycemic control. Parents may also unnecessarily and excessively restrict the intake of carbohydrates to prevent high blood sugars.

FAMILY VARIABLES

The family environment appears to be particularly important in the adjustment of children with a chronic illness such as diabetes.[21] Whereas research indicates that high family cohesion is positively correlated with good glycemic control,[22] low family cohesion is associated with high levels of avoidant coping.[23] Research also indicates that there is a bi-directional relationship between family stress and glycemic control. That is, high levels of family stress are correlated with poor control and poor control can produce family stress.[24] Children with poor glycemic control were more likely to use maladaptive coping strategies than those with good glycemic control.[25] In addition, high levels of family conflict, especially during adolescence are associated with poor metabolic control.[26] Conversely, positive family communication and problem solving skills are correlated with good adjustment.[26] Furthermore, when children perceive their parents as warm and supportive, they are less likely to experience episodes of DKA[27] whereas youth who report critical parenting related to their diabetes management were more likely to be in poor glycemic control.[28]

PARENTING AND ADHERENCE

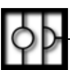
Some parents attempt to control all aspects of their child's care and even provide rigid rules and structure in other areas of their lives with resultant parent-child conflict.[14] For example, parents may not allow children to attend social functions or visit friends to monitor health behaviors more closely. Other parents prematurely place full responsibility on the child, despite the child having inadequate cognitive, emotional and behavioral maturity. An example of this phenomenon involves parents who feel the child should remember to check blood glucose levels, count carbohydrates, calculate and then administer the appropriate amount of insulin with meals. This complexity may lead to frustration and a sense of failure for both the child and the parent if the child is not yet ready to accept that level of responsibility. Both strategies often result in nonadherence and poor metabolic control.

In terms of overly controlled parents, it is helpful to problem-solve about ways to increase responsibility and manage their own anxiety. Health professionals can emphasize that youth are more likely to be adherent if they feel they are participating in the decision making process regarding their own diabetes. Children and adolescents should be given as much responsibility as they can handle successfully within their developmental level. Conversely, for parents who have abrogated their responsibility too early, it is necessary to convey that diabetes is a family disease and that increased parental monitoring and supervision is essential.[29] Supervision of the diabetes treatment regimen needs to be carried out in a developmentally appropriate way. For instance, parents of younger children are likely to have primary responsibility for administering treatments. As children mature, primary responsibility for the diabetes-related tasks may be reduced as the child demonstrates being able to accept more self-care responsibility. However, supervision before and during adolescence continues to be of critical importance. The parent must understand that children have poorer diabetes outcomes when their self-care responsibilities exceed their psychological maturity.[30]

PARENTING STRATEGIES

Parents can learn more effective techniques for supervising and helping to manage health behaviors. Behavioral strategies, such as contracts, monitoring behaviors (e.g., reviewing the pump history every night), successive scaffolding of responsibility, praising and encouraging, and employing token economies (e.g., tokens or points, which are earned by completing desired behaviors, can be exchanged for greater rewards such as a trip to the movies) are most effective in promoting adherence.[31, 32] Parents are recommended to balance their involvement in their child's care with the child's desire for independence and need for gradual increased responsibility in a supportive and encouraging manner while avoiding negativity, criticisms, nagging and verbal or physical aggression.

Positive parenting strategies such as conveying warmth, encouragement and praise are often associated with better adherence.[33] The use of encouragement increases self-esteem, and builds feelings of self-efficacy.



It is recommended that parents focus on the positive, on what the child did correctly, such as monitoring blood glucose checks or remembering insulin administration, rather than pointing out times he or she had to be reminded. Parents are encouraged to reward rather than punish and to focus on assets and strengths to help children learn from mistakes. Supervision and monitoring should occur in a sympathetic and constructive way while also emphasizing the importance of adherence.[34]

Behavioral strategies can be helpful for increasing the cooperation with regimen behaviors.[34] A behavioral contract is often a successful tool for getting the youth to "buy in" to their diabetes treatment regimen.[31] A behavior contract is an agreement that is written by both the child care diabetes team and the child, which gives the child explicit behavioral goals and allows the child to earn small weekly rewards or privileges by fulfilling verified treatment and testing requirements. Effective contracts are based upon genuine negotiation among adolescents and parents, or members of the diabetes team and families and encompass clearly defined goals, and methods of verifying progress toward those goals. Behavioral incentives are another effective tool that can bridge the gap between the long term benefits of adherence and the immediate benefits from adherence that ultimately are more meaningful to children and adolescents.

RECOMMENDATIONS

Health care educators can help parents and school staff by directing them toward education materials about diabetes such as basic guides or other web based resources. Also, it is normal for parents and children to experience many emotions and normalizing feelings such as sadness, anger, guilt, or anxiety can help them understand, cope with and respond more effectively to their grief. Individuals working with these patients can respond best by using active listening skills and being empathic ("It sounds like you feel really scared." "You are not sure what is going to happen." "Diabetes is scary."). Patients should be encouraged to express their feelings and concerns without judgment or attempts to decrease their emotions ("Tell me more. I want to know how you feel."). Patients that are experiencing emotional concerns in excess of what is expected from the natural expression of grief and coping with a chronic illness should be referred to a professional mental health counselor.

Children and families coping with diabetes face a number of challenges in addition to complex medical regimens. Adjustment and quality of life in children with diabetes is affected by many factors, the most important being family support and ability of the family to cope with the emotional reactions to a chronic illness such as depression, anger, anxiety and guilt. Further, living with a chronic illness can impact the social lives of youth in the school as well as at home and may affect their ability to have healthy interpersonal relationships. Parent response and coping is one of the best predictors of successful adjustment and behavioral strategies and positive parenting can help youth better respond to the stressors in their lives. Health care professionals can help parents and children by being knowledgeable about these issues in order to provide assessment, support and education as needed. Further, being aware of potential psychosocial issues can help those working with children and adolescents with diabetes decide when to make referrals to mental health professionals.

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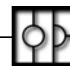

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Feature Article

Lowering Risk for Type 2 Diabetes in High-risk Youth

Nichole Bobo, Shirley Schantz, Francine R. Kaufman, and Sobha Kollipara

ABSTRACT

Among children and youth who develop type 2 diabetes (T2DM) there are a number of genetic and environmental factors that lead to a combination of insulin resistance and relative-cell secretory failure of the pancreas. These factors include ethnicity (highest in American Indian youth), obesity, sedentary behavior, family history of T2DM, puberty, low birth weight, intrauterine diabetes exposure and female gender. The American Diabetes Association (ADA) has recommended guidelines to screen children and youth for diabetes risk. School nurses in a National Association of School Nurses' program use the ADA guidelines, and then refer at-risk children to a health care provider for further evaluation and intervention. The HEALTHY trial funded by the National Institutes of Health is assessing whether school-based strategies can reduce diabetes risk. Prevention and intervention of overweight and obesity in children—a risk factor for the development of T2DM in children and youth—is a shared responsibility among parents, schools, health care providers and communities.

Bobo N, Schantz S, Kaufman FR, Kollipara S. Lowering risk for type 2 diabetes in high-risk youth. Am J Health Educ. *2009;40(5):282-284. This paper is part of a sponsored set of papers contributed through the National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health.*

INTRODUCTION

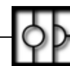
The epidemic of childhood overweight and obesity has become a leading national and international public health issue. The long-term consequences are yet to be realized, although most believe that this issue will adversely affect the health and health care costs in our nation and throughout the world. As a result of obesity, it is estimated that this generation of young people will be the first expected not to live as long as their parents, and for children born in 2000, the lifetime risk of developing diabetes is estimated to be 30% in girls and 40% in boys, if nothing is done.[1]

YOUTH AT RISK FOR TYPE 2 DIABETES

Overweight and obese children are presented with multiple co-morbid conditions that had previously been thought of as diseases of adults, most significant of which is type 2 diabetes (T2DM).[2-5] The SEARCH for Diabetes in Youth Study has helped define the prevalence of diabetes in youth in the United States (U.S.).[6] SEARCH collected data from six states: California, Colorado, Hawaii, Ohio, South Carolina and Washington to determine the prevalence of diabetes in two age groups (0-9 years and 10-19 years), and for non-Hispanic Whites, Hispanics, African Americans, Asian/Pacific Islanders and American Indians. The study determined that race/ethnicity and gender differences accounted for the different prevalence rates of type 1 (T1DM) and T2DM.[6]

In the 0-9 year age group, T1DM accounted for more than 80% in the total cohort. For American Indian children in this age group, T2DM accounted for 13%.

Nichole Bobo is a nursing education director, National Association of School Nurses, Silver Spring, MD 20910; E-mail: nbobo@nasn.org. Shirley Schantz is a nursing education director, National Association of School Nurses, Silver Spring, MD 20910; E-mail: sschantz@nasn.org. Francine R. Kaufman is the chief medical officer and Emeritus professor of Pediatrics, Keck School of Medicine, University of Southern California and Children's Hospital of Los Angeles, Los Angeles, CA 90027; E-mail: fkaufman@chla.usc.edu. Sobha Kollipara is director, Pediatric Endocrinology and Diabetes, Kaiser Permanente Roseville, Roseville, CA 95661; E-mail: sobha.kollipara@kp.org



For the 10-19 year age group, the percentage of T2DM was highest in American Indian youth (76%), 40% in Asian/Pacific Islander youth, 33% in African American youth and 22% in Hispanic youth. T2DM rates were the lowest among non-Hispanic Whites in the 10-19 year age group, accounting for only 6% of diabetes, whereas T1DM accounted for more than 91%. In general, the incidence of T2DM is increasing nationally. In one clinic-based study there was a ten-fold increase over a 12-year period. T2DM now accounts for 15% to 45% of newly diagnosed cases of diabetes,[7] with the incidence dependent on the ethnicity of the population being studied.

Among children and youth, as in adults, T2DM is due to the combination of insulin resistance and relative β-cell secretory failure. There are a number of genetic and environmental risk factors for insulin resistance and limited β-cell reserve including ethnicity, obesity, sedentary behavior, family history of T2DM, puberty, intrauterine growth retardation, intrauterine diabetes exposure and female gender. Environmental factors also play a key role in development of diabetes. Globalization and industrialization are making high-density, low-nutrient food and drinks available to people worldwide and also are responsible for an increasing tendency for children to be sedentary and unfit. This combination of factors has led to a global epidemic of obesity as a major risk factor for T2DM.

SCREENING CHILDREN AT RISK FOR TYPE 2 DIABETES

American Diabetes Association (ADA) guidelines[8] recommend screening for T2DM in children if they are 10 years of age or when puberty occurs, and should be repeated every two years if children have a body mass index (BMI) at or greater than the 85th percentile for age and gender and have two or more of the following risk factors:

- Family history of T2DM in a first or second degree relative
- High risk race/ethnicity (Native American, African American, Hispanic/Latino, Asian American, Pacific Islander)
- Signs of insulin resistance or conditions associated with insulin resistance (acanthosis nigricans [a light brown-black, rough or thickened are on the surface of the skin], hypertension, high cholesterol and/or triglycerides, or polycystic ovary syndrome [changes in hormone levels])
- Maternal history of diabetes or\stational diabetes mellitus

Children identified as being at risk should be referred to a health care provider for further assessment and implementation of preventive or treatment measures. Diagnosis of T2DM is confirmed with a fasting plasma glucose because of ease of administration, compared to a two-hour glucose tolerance test.[8] The A1C test may be an adjunctive test to diagnose diabetes in the future.

LOWERING THE RISKS FOR T2DM IN CHILDREN: SAMPLE APPROACHES

Prevention and intervention of overweight and obesity in children is a shared responsibility among parents, schools, health care providers and communities. Because children spend so much of each day at school, "schools are one of the primary locations for reaching the nation's children and youth."[9]

One example of a school-based project is the National Association of School Nurses' (NASN) Managing and Preventing Diabetes and Weight Gain (MAP) program. This five-year program is funded by the CDC Division of Diabetes Translation's "National Program to Promote Diabetes Education Strategies in Minority Communities: The National Diabetes Education Program." The focus of this program, currently being implemented at four large urban school districts and in one state, is to *use the intimate and credible relationships school nurses have with the communities they serve to strengthen and encourage positive behaviors in the prevention and management of diabetes.* Note that whereas the MAP program addresses both management and reducing the risk of diabetes in children and adolescents at school, the current paper focuses only on lowering risk for T2DM in high-risk youth.

School nurses in this program are first provided with the education, tools and resources to understand the scope of the problem, screen students and make appropriate referrals through a standardized continuing education program. Ongoing support is provided by a diabetes prevention resource nurse who has content, clinical and coaching expertise. Participating school nurses at each MAP affiliate site who have completed the required education conduct BMI screenings for third-grade through fifth-grade classes. A student with a BMI at the 85th percentile or greater (for age and gender) is further screened for the presence of additional risk factors such as family history, belonging to a high-risk racial or ethnic group, signs of insulin resistance, or maternal history of diabetes or gestational diabetes.

Students identified as high risk are referred to primary health care providers for additional assessment and implementation of preventive or treatment measures if necessary using a MAP referral form that includes recommended next steps developed by the American Diabetes Association and the American Heart Association. Concurrently, school nurses communicate with students' families about the health of their child (including use of a MAP form), connect high-risk students and families with community resources, advocate for change in school health policies, and participate in local and state coalitions related to childhood overweight and T2DM. School nurses also are provided with resources to facilitate classroom education on healthy lifestyles for targeted classes.

School nurses at MAP affiliate sites are recognized as key partners in addressing the issue of childhood overweight and obesity at the local and state levels, as noted by their active coalition involvement. They also are recognized at the national level. School nurses have been invited to participate in the U.S. Surgeon General's national tour "Childhood Overweight and Obesity Prevention Initiative *'Healthy Youth for a Healthy Future'*" which highlights those communities with effective prevention programs. The Surgeon General has indicated to the National

Association of School Nurses that a nurse should be present at all state discussions about childhood obesity. To date, school nurses have participated in discussions in New Mexico, Texas, Alabama, South Dakota, Virginia, Georgia and Rhode Island.

Another example of an approach to lower the risk of T2DM in youth is the HEALTHY trial. The National Institutes of Health is funding the HEALTHY trial to determine if school-based strategies can reduce risk factors for diabetes in a large cohort of middle school students. The main risk factor of interest is a BMI > 85th percentile. The HEALTHY trial began in 2006 in seven sites and involves 42 schools, half of which are in the intervention and half in the control arms. The study group is working with the school staff in the intervention schools to help change cafeteria offerings, as well as the competitive food offerings. The study group also is working with physical education staff to enhance lesson plans and teaching methods to increase moderate to vigorous physical activity during physical education classes. A ten-week classroom curriculum to enhance behavior change is offered over five semesters, focusing on increasing water intake, active versus sedentary behavior, food quality, and energy balance and maintaining a healthy lifestyle. There are a series of school-wide campaigns that employ a number of strategies to get student, parent or guardian, and teacher buy-in in healthy behaviors. This comprehensive school approach aims to reduce risk factors for diabetes. The outcome assesses at-risk levels of BMI between the intervention and comparison schools, as well as elevated fasting plasma glucose and insulin levels.

In anticipation of the full trial, data were collected in a cohort of eighth-graders in predominantly minority schools, and results were published in *Diabetes Care* in 2006.[10] The goal was to determine how many eighth-grade students had diabetes or abnormalities of glucose or insulin levels measured while fasting and with an oral glucose tolerance test. Data were collected during school from more than 1,700 students in 12 middle schools in three clinical centers. Almost 50% had a BMI greater than the 85th percentile, 39% had a fasting glucose level in the abnormal range compatible with impaired fasting glucose (between 100-126 mg/dl), and 36% had what was considered a high fasting insulin level (greater than 30 uU/ml). Insulin and glucose levels increased with increasing BMI percentile, and fasting glucose was highest in Hispanic and Native American students. This pilot showed that there is a high prevalence of risk factors for diabetes in middle school students in schools with a high minority census; however, few students (less than 1%) were found to have undiagnosed diabetes.

RESOURCES FOR HIGH-RISK YOUTH

National Association of School Nurses (NASN)

• Tools to manage and prevent diabetes: http://www.nasn.org/Default.aspx?tabid=324

• School Nurse Childhood Obesity Prevention Education: http://www.nasn.org/Default.aspx?tabid=435

National Diabetes Education Program (NDEP)

• *Tips for teens-lower your risk for type 2 diabetes:* http://www.ndep.nih.gov/publications/PublicationDetail.aspx?PubId=103

• *Move it! and reduce your risk of diabetes school kit: http://www.ndep.nih.gov/publications/PublicationDetail.aspx?PubId=96*

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) Weight Information Network

• Resources for children and adolescents: http://win.niddk.nih.gov/publications/index.htm#public

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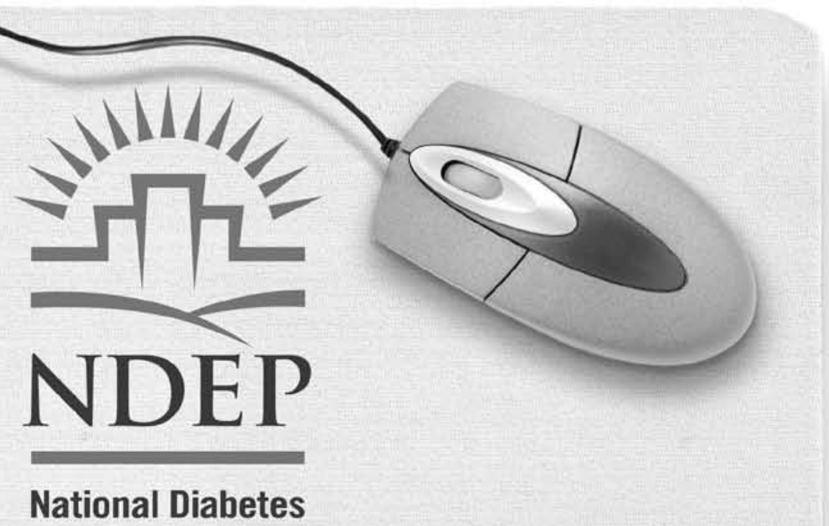

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Feature Article

Effects of Physical Activity on Diabetes Management and Lowering Risk for Type 2 Diabetes

Connie L. Tompkins, Arlette Soros, Melinda S. Sothern, and Alfonso Vargas

ABSTRACT

Physical activity is a proven form of diabetes management and is considered a cornerstone in the prevention of diabetes. In children with diabetes, physical activity may improve insulin sensitivity and glucose uptake in skeletal muscle. Aerobic-based physical activity lasting 40-60 minutes daily for a minimum of four months is shown to enhance insulin sensitivity, and may reduce the risk for type 2 diabetes. An important adjunct to aerobic-based physical activity for diabetes prevention is resistance training. The American Academy of Pediatrics supports properly supervised strength/resistance training as a safe method for strength development in preadolescent children. Resistance training may increase skeletal muscle mass, therefore increasing whole-body glucose disposal capacity. In addition to immediate health benefits during childhood, increased physical activity in children and adolescents is likely to contribute to the establishment of healthy leisure habits over a lifetime and improved adult cardiovascular health. Large-scale intervention studies, however, are needed to determine the most effective physical activity strategies for prevention and management of type 2 diabetes in children and adolescents.

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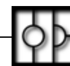
INTRODUCTION

Adiposity is a major determinant of type 2 diabetes in children and adolescents and is the most relevant modifiable diabetes risk factor in youth.[1-3] Lifestyle modifications are necessary to manage established diabetes successfully and to lower the risk for type 2 diabetes in high-risk youth. In addition to diet, physical activity is a proven form of diabetes management and is considered a cornerstone in the prevention of diabetes.[1-3] Participation in physical activity is shown to improve body composition and decrease resting heart rate and blood pressure in children and adolescents. In children with diabetes, however, physical activity may provide additional advantages.[4] By improving both insulin sensitivity and glucose uptake in skeletal muscle,[2,3] physical activity may have the potential to reduce the incidence of type

Connie L. Tompkins is a postdoctoral researcher, Tulane University Health Sciences Center School of Medicine, Tulane University, New Orleans, LA 70112; E-mail: ctompkin@tulane.edu. Arlette Soros is a Pediatric Endocrinology Research fellow, Department of Pediatrics, Louisiana State University Health Sciences Center and Children's Hospital, Louisiana State University, New Orleans, LA 70118; Email: asoros@lsuhsc.edu. Melinda S. Sothern is a professor and director, Section of Health Promotion Behavioral and Community Health Sciences Department, School of Public Health, Louisiana State University Health Sciences Center, Louisiana State University, New Orleans, LA 70112; Email: msothe@lsuhsc.edu. Alfonso Vargas, MD is a professor of pediatrics, Louisiana State University Health Sciences Center and Children's Hospital, Louisiana State University, New Orleans, LA 70118; Email: avarga@lsuhsc.edu.



2 diabetes in children and adolescents.[3]

Type 2 diabetes mellitus is associated with insulin resistance.[5] Studies performed in children and adolescents demonstrate a positive association between physical activity and insulin dynamics, with increased activity significantly related to lower fasting insulin and greater insulin sensitivity.[3,6] Physical activity may improve insulin sensitivity by enhancing glucose transport into muscle cells and increasing the production of muscle glycogen to replace the amount used during exercise.[7] Furthermore, the long-term improvements in insulin sensitivity that follow exercise training may be explained by an increase in fat-free mass; thereby increasing the volume of muscle tissue into which glucose can be transported. In addition, these outcomes may be further enhanced by a concomitant decrease in fat mass and a resulting decrease in inflammatory adipokines.[3]

Most randomized controlled trials in overweight children and adolescents have shown that physical activity enhances insulin sensitivity in childhood. Nassis et al.[6] examined the effects of an aerobic exercise training program on insulin sensitivity in overweight and obese 9-15 year olds. After 12 weeks of training, insulin sensitivity increased without changes in body weight or percent fat mass. Moreover, after the training, lower limb fat free mass increased by 6.2%, a change that was significantly associated with enhanced insulin sensitivity.[6] Kahle[9] also observed a significant decrease in fasting insulin in obese adolescent males after 15 weeks of mild intensity training.

Ferguson[8] observed significantly decreased fasting insulin in seventy-nine obese 7-11 year-old children after four months of exercise training. However, no significant changes in fasting glucose were observed. Unfortunately, eight months after the training program ceased, the beneficial effects of the exercise on fasting insulin were removed.

Several other studies demonstrated improved insulin sensitivity and glucose metabolism following aerobic training in overweight and obese children between the ages of 9 and 16 years of age.[3,6] These improvements were observed without changes in body weight or fat, suggesting that the improvement in insulin sensitivity may be due to changes in the ability of the muscles to metabolize glucose. These findings support previous studies in adults that reported physical training-induced improvements in insulin sensitivity without changes in body fat.[10] Likewise, studies evaluating exercise and diet together resulted in a decrease in fasting blood glucose and HgbA1C levels in children. Conversely, similar evaluations of diet alone demonstrated no significant reductions in blood glucose concentrations.[1,9,11]

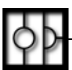
Schmitz et al.[3] observed the effect of physical activity on insulin resistance and other cardiovascular disease factors in 357 healthy weight children without diabetes (age range 10-16 years). Significant correlations were observed between self-reported physical activity and both fasting insulin and insulin sensitivity. Moreover, in the subset of children with higher systolic blood pressure[3], the correlations were significantly stronger. Conversely, two other studies did not find significant differences in insulin after physical activity. Kang[13] reported no significant changes in fasting insulin after eight months of moderate to vigorous physical training in 80 obese youths. Additionally, no significant reductions in fasting insulin were observed by Treuth and colleagues[14] over five months of resistance training in twelve obese prepubertal girls.

Whereas physical activity is recommended to help increase insulin sensitivity, resistance training, specifically, may provide additional benefits. Compared to endurance training, resistance training may substantially increase skeletal muscle mass and strength and, thus, whole-body glucose disposal capacity.[7,12] Recent investigations report significant metabolic benefits of resistance training in children and adolescents. Shaibi and colleagues[12] examined the effects of a 16-week resistance training program in twenty-two overweight Latino adolescent males randomly assigned to two-times-per-week resistance training or a non-exercising control condition. Significant increases in strength as measured by 1-rep max were observed in the resistance training group. More importantly, insulin sensitivity measured by the frequently sampled intravenous glucose tolerance test with minimal modeling was significantly improved (45.1+/-7.3% in the resistance training group versus -0.9+/-12.9% in the control group). Remarkably, these results remained significant after adjusting for fat and lean mass by DEXA. In another investigation, Benson and others[15] examined the relationship between upper body strength and insulin resistance in a large cohort (N=126) children, 10-15 years of age. Poor upper body strength was an independent predictor of insulin resistance. And, children in the highest and middle tertiles of absolute upper body strength were 98% less likely to have high insulin resistance than those with the lowest strength even after adjusting for maturation, central adiposity and body mass. Thus, resistance or strength training should be considered as a safe and effective modality of exercise in children at risk for developing type 2 diabetes. This coincides with recent recommendations by the U.S. Government Physical Activity Guidelines for American Children and Adolescents[16] which include bone- and muscle-strengthening activities for inclusion into each day's minimum of 60 minutes of physical activity.

PHYSICAL ACTIVITY RECOMMENDATIONS

Reducing overweight and impaired glucose tolerance with increased physical activity and healthier eating habits may help prevent or delay development of type 2 diabetes in high-risk children and adolescents.Children with a BMI greater than the 85th percentile for age and sex should be counseled to increase physical activity and reduce weight gain while allowing for normal growth and development. With the decrease in physical activity and the increase in prevalence of type 2 diabetes in children and adolescents, educators, researchers and parents need to place a higher priority on increasing children's physical activity.[2]

Children and adolescents at metabolic



risk should partake in regular, moderate intensity physical activity. This activity should be performed for at least 30 minutes, but preferably 45-60 minutes, at least five days per week. An increase in physical exercise may accompany this recommendation as part of the child's daily lifestyle activities.[17] For prevention and management of type 2 diabetes in children and adolescents, aerobic-based exercise lasting 40-60 minutes daily for a minimum of four months is likely to enhance insulin sensitivity, and may reduce the risk for type 2 diabetes in children and adolescents.

Evidence-based recommendations for physical activity in school-age youth include participation in 60 minutes or more of moderate to vigorous activity. This activity should be enjoyable, developmentally appropriate and involve a variety of activities.[18] The following evidence-based recommendations for physical activity in school-age youth are broken down by type and modality:[18]

Preschool years: General movement activities (jumping, throwing, running, climbing)

Pre-pubertal (6-9 years): More specialized and complex movements, anaerobic (tag, games, recreational sports)

Puberty (10-14 years): Organized sports, skill development

Adolescence (15-18 years): More structured health and fitness activities, refinement of skills

Physically inactive children and adolescents should take an incremental approach to reach the 60 minutes per day recommendation, increasing overall physical activity by 10% each week.[18] Tables 1, 2, and 3 provide recommendations for frequency, duration, and activity.[19,20]

Additionally, resistance training should be considered an important adjunct to aerobic-based physical activity for diabetes prevention programs in high-risk youth, independent of changes in body composition.[21] The prepubescent child, in particular, is at an increased risk of injury due to a reduction in joint flexibility caused by rapid growth in the long bones. Young children should

Table 1. Moderate Intensity Progressive Exercise Prescribed Duration of Exercise (minutes per session)[19]

	Week 1	Week 5	Week 10
Overweight	30	45	60
Obese	25	40	55
Severely Obese	20	35	50

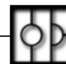
Table 2. Moderate Intensity Progressive Exercise Prescribed Frequency of Exercise (days per week).[19]

	Week 1	Week 5	Week 10
Overweight	3	4.5	6
Obese	2	4	5.5
Severely Obese	1	3	5

Table 3. Initial* Activity Recommendations According to Body Mass Index (BMI) for Overweight, Obese, and Severely Obese Children and Adolescents.[20]

Overweight Children (>85th-95th BMI), 7-18 Years	▪ Limited access to TV, video games, computer ▪ Recommended aerobic activities: Weight-bearing such as brisk walking, treadmill, field sports, roller blading, hiking, racquetball, tennis, martial arts, skiing, jump rope, indoor/outdoor tag games ▪ Parent training and fitness education ▪ Pacing skills
Obese Children (>95th-99th BMI), 7-18 Years	▪ Limited access to TV, video games, computer ▪ Recommended aerobic activities: Non-weight bearing such as swimming, cycling, strength/aerobic circuit training, arm ergometer (crank), recline bike, and interval walking (walking with frequent rests, as necessary) ▪ Parent training and fitness education
Severely Obese Children (>99th BMI), 7-18 Years	▪ Limited access to TV, video games, computer ▪ Recommended aerobic activities: Non-weight bearing such as swimming, recline bike, arm ergometer (crank), seated (chair) aerobics, and seated or lying circuit training ▪ Parent training and fitness education ▪ Other emotional and dietary concerns addressed during treatment

* Recommendations should be adjusted every 10-12 weeks based on individual progress.



be provided safe opportunities to climb, run and jump to encourage development of muscular strength and endurance.[20]

Strength training suggestions for prepubescent children include the following:[20]

- Climbing trees
- Swinging on monkey bars
- Supervised jumping activities
- Swinging on a swing set
- Skipping rope
- Playing hopscotch
- Climbing into and out of a swimming pool
- Participating in gymnastics
- Dancing
- Learning a martial art

Strength training also reduces the incidence of overuse injury in the prepubescent child.[21] Inclusion of regular resistance training in a program to prevent and treat pediatric obesity in preadolescent children is not only feasible, but also safe, and may contribute to retention at one year.[21,22] Recently, a meta-analysis examined thirty childhood obesity treatment studies that included an exercise intervention.[23] Significant improvements in body composition were associated with programs that included high-repetition strength training in conjunction with moderate intensity aerobic exercise. Thus, the combination of high-repetition resistance training, moderate aerobic exercise and behavioral modification may be most efficacious for reducing body fat variables in overweight children. However, pediatric health care providers should be careful when recommending strength training to obese children and to children with diabetes.[19]

The American Academy of Pediatrics separates the terms resistance training and strength training from the terms weight lifting, power lifting, and body building[24] and supports properly supervised strength/resistance training programs as safe methods for strength development in preadolescent children and adolescents. The following strength training guidelines for children and adolescents should be adhered to:[20, 21]

- Begin the program using weight at about 60% of what you can lift in one try (this baseline is called the one repetition maximum or your "1 rep max").
- Lift the same amount of weight at each workout until you can perform 12 repetitions in perfect form, with little effort.
- When you are able to do a strength exercise perfectly 12 times, increase the weight by one to two pounds.
- Use a 2-4 second count to lift and lower the weight.
- Begin doing strength exercises once per week, gradually working up to twice per week. Never do strength exercises more than three times per week. *Always rest at least one day between strength workouts.*
- Rest one to two minutes after each set of 8 to 12 repetitions. One set of each strength exercise is recommended for children under age 14. One or two sets are recommended for older children.
- Isolate and focus on the muscles you are working by keeping all the other parts of the body stationary and relaxed (abdominals should always be pulled in, also glutes for standing exercises).
- Fully extend and contract the muscles without locking the joints when you are performing each strength exercise.
- Grip the weight handles lightly to prevent an increase in blood pressure.
- Breathe normally throughout the exercises.

Flexibility training, or stretching, is just as important as aerobic and strength training. Inflexible joints and muscles can inhibit children from participating in activities to their fullest potential. Inflexibility also can lead to chronic muscle and joint disorders. Stretching should be performed after aerobic or strengthening exercises to help prevent soreness and possible injury.[20]

With childhood obesity more prevalent now than in past generations, treatment programs that produce lasting results are sorely needed. *Trim Kids*, a clinic-based, interdisciplinary and multilevel weight management program, incorporates short-term goal setting, regular feedback and motivational techniques to improve health behaviors.[20] Evaluations indicate that *Trim Kids* is effective in helping children lose weight and maintain weight loss at one-year follow-up.[25] To help combat childhood obesity, the *Trim Kids* program was implemented in YMCA centers across Southeast Louisiana. The Louisiana State University Health Sciences Center (LSUHSC), School of Public Health provided a two-day training session for staff members at the YMCA centers. Intervention programs were launched in seven locations with YMCA staff providing the nutrition and physical activity interventions and staff from LSUHSC providing the behavioral component. *Trim Kids* was recognized by the National Cancer Institute as a Research Tested Intervention Program and recently was acknowledged by the U.S. Surgeon General for its community dissemination in YMCA centers in Louisiana.[26]

In addition to immediate health benefits during childhood, increased physical activity in children and adolescents is likely to contribute to the establishment of healthy leisure habits over a lifetime and improved adult cardiovascular health.[3] Large-scale intervention studies are needed to determine the most effective physical activity strategies for prevention and management of type 2 diabetes in children and adolescents.[2] Physical activity should be sustained, however, throughout adolescence as improvements in insulin sensitivity are reversed following cessation of exercise.[2]

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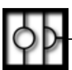

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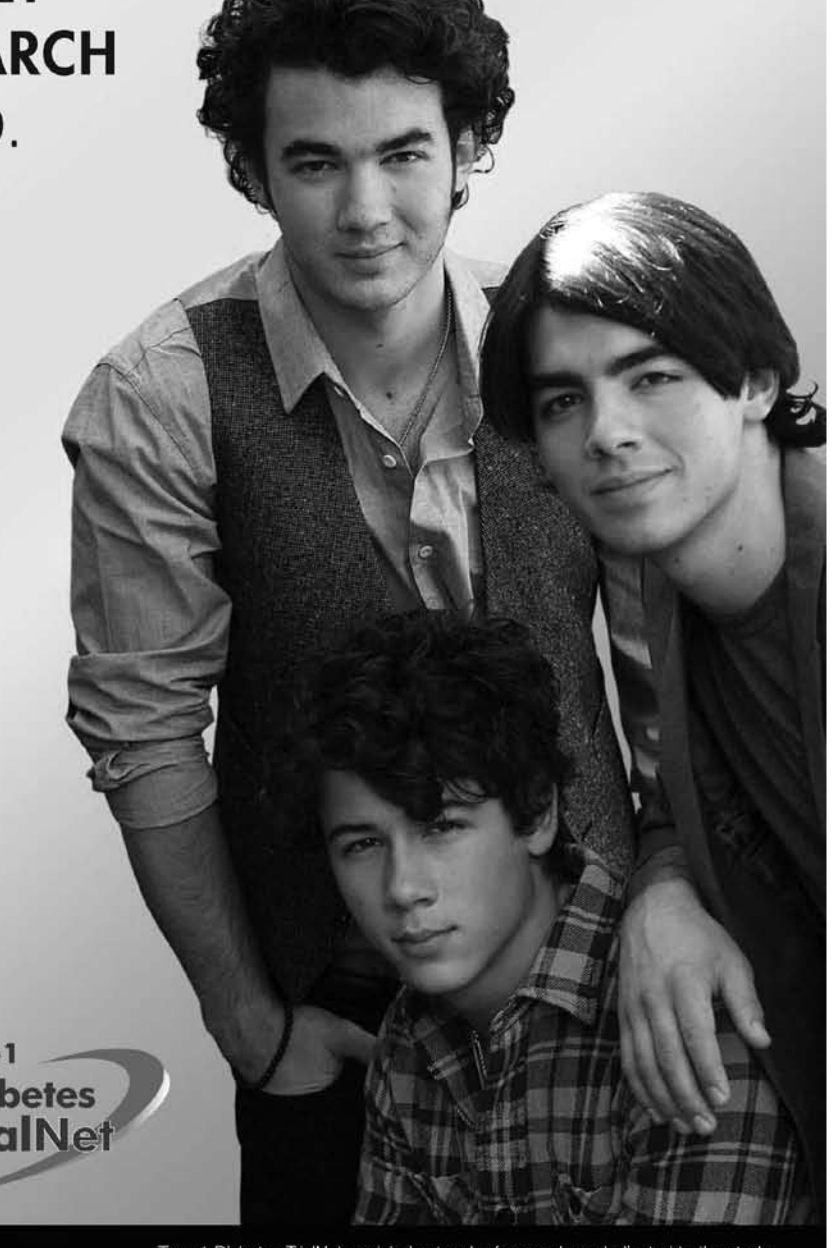
A message from

THE JONAS BROTHERS

IF TYPE 1 DIABETES IS IN YOUR FAMILY, GET INVOLVED IN RESEARCH AND GET SCREENED.

A simple blood test may be able to detect an increased risk for type 1 diabetes up to 10 years before symptoms appear. This test is available to eligible family members of people with type 1 diabetes through TrialNet, an international research effort led by the National Institutes of Health.

Those found to be at increased risk may be eligible to join research studies that are testing ways to prevent and delay type 1 diabetes.



GET INVOLVED.
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Type 1 Diabetes TrialNet

For more information about TrialNet, call 1-800-425-8361 or visit www.DiabetesTrialNet.org

Type 1 Diabetes TrialNet, a global network of researchers dedicated to the study, prevention, early detection and early treatment of type 1 diabetes, is supported by:

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Feature Article

Diabetes Technologies and Their Role in Diabetes Management

Sobha Kollipara, Janet H. Silverstein, and Katie Marschilok

ABSTRACT

The 1993 Diabetes Complications and Control Trial (DCCT) showed that controlling blood glucose prevents and delays the progression of long term complications of diabetes. New diabetes technologies can make control of diabetes possible and safer. This paper reviews these technologies used to monitor blood glucose, administer insulin and evaluate effectiveness of therapy. Self-monitoring of blood glucose has been a standard of care for several decades. Today, patients and practitioners can gain great benefit from data that can be provided by using Continuous Glucose Monitoring (CGM). Current physiologic insulin therapy regimens have improved blood glucose control capabilities. Insulin therapy devices; including pens and pumps are reviewed. Advantages of insulin pump therapy and features of the latest 'smart' pumps are described. Children with diabetes, and their families, have many challenges as well as many opportunities to employ new technologies in diabetes management plans. The ability of school and care givers to support children can impact the overall success of any diabetes therapy regimen.

Kollipara S, Silverstein JH, Marschilok K. Diabetes technologies and their role in diabetes management. Am J Health Educ. *2009;40(5):292-297. This paper is part of a sponsored set of papers contributed through the National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health.*

INTRODUCTION

The control of diabetes and its effects on long-term morbidity are well known. Many new ideas and modalities have been explored that target improved methods to monitor blood glucose and deliver insulin to achieve better metabolic control. Over the years, technological advances in these areas have made it possible to improve blood glucose control. This review addresses these newer technologies such as:

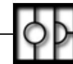
- Blood glucose (BG) monitoring
- Real time continuous glucose monitoring (CGM)
- Insulin delivery with insulin pens and pumps
- The closed loop system (artificial pancreas)
- Blood Glucose Monitoring

Blood glucose monitoring as a means of assessing diabetes control has been used since the 1970s and is an essential clinical tool in day-to-day diabetes management. The Diabetes Control and Complication Trial clearly has shown that good control of BG improves short- and long-term microvascular complications.[1] Because of technological advances, the devices that monitor blood glucose are more accurate and efficient than ever before.

BG monitoring is done using two methods: blood glucose meters for checking blood glucose levels at discrete times, most commonly used for day-to-day diabetes management; and continuous glucose monitoring.

Blood glucose meters. Self-monitoring of blood glucose (SMBG) is the essence of day-to-day diabetes control. SMBG enables patients and their health care providers to make medication adjustments that achieve and maintain optimal glycemia. Over the

Sobha Kollipara is the director, Pediatric Endocrinlolgy and Diabetes, Kaiser Permanente Roseville, Roseville, CA 95611; E-mail: sobha.kollipara@kp.org. Janet H. Silverstein is a professor and chief in the Pediatric Endocrinology Department, University of Florida, Gainesville, FL 32608; E-mail: silvejh@peds.ufl.edu. Katie Marschilok is a diabetes clinical manager, Medtronic Diabetes, 4 Fairlawn Lane, Troy, NY, 12180; E-mail: katie.k.marschilok@medtronic.com.



last decade, glucose meters have dramatically improved in their ease of use, in time required to perform the test and in volume of blood required.

Technology of the glucose meters. All glucose meters use enzymes that oxidize the glucose in the blood sample. Electrons released from the glucose by this reaction generate an electrochemical current that is measured as a digital value displayed on a screen. The amount of current released is proportional to the glucose concentration. Most of the meters use this method for glucose measurement. Though most of the meters contain sensors that adjust and correct to the outside temperature, glucose strips used for meters may give inaccurate readings in extreme hot or cold weather. It is advisable to wait before testing to assure that strips are at room temperature, to eliminate errors.

Accuracy and precision. All glucose meters in use today are reasonably accurate, with blood glucose values being within 5% (5mg/dl <100mg/dl) of the lab value if done with capillary blood from the finger. There is also good reproducibility, with blood glucose results from the same drop of blood on two separate occasions having little variability, differing by only 2% to 3%.[2] The difference in readings between two meters using the same drop of blood has been shown to be less than 4%.[3]

Most meters need only about 0.3 to 10 µl of blood to function. Most current meters are calibrated for capillary blood from finger tips. There is an increasing demand for testing at alternate sites because of the discomfort of the frequent finger pricking. Some meters are FDA approved for alternate site testing with the forearm being the most popular site, though the abdomen, thigh and other areas of the body may be used. However, there are limitations to the use of alternate sites. There is lag time between the actual blood/capillary glucose (finger prick) to that of interstitial (other sites), resulting in delayed recognition of hypoglycemia.[4] Accuracy of the level is affected for the samples obtained after exercise and one-hour post-prandial (after a meal), especially if glucose levels are low.[5]

Data storage and reproducibility. All meters are equipped with memory of data storage in many different formats. In addition to the blood glucose data, other information such as food and exercise data can be stored. These stored data can be imported into patient's charts using software for uploading, transmitted to insulin pumps and communicated to health care providers via web-based programs. The computer data displays are used to estimate the glucose trends; average and standard deviations that help to identify insulin adjustment needs. The new glucose meters are easy to use resulting in improved patient acceptance and motivation to improve diabetes control.

CONTINUOUS GLUCOSE MONITORING (CGM)

Continuous glucose monitoring recently has been approved by the FDA and provides an additional tool for diabetes management. These monitoring devices are approximately the size of a cellular phone and are worn on a belt or in a pocket. A sensor is inserted through a plastic cannula under the skin, in the subcutaneous tissue. Glucose values are displayed on a digital screen every few minutes with arrows or other indicators of blood glucose trends, allowing the adjustment of food or insulin early to prevent low or high blood glucose levels. Several FDA approved devices are available commercially for continuous glucose monitoring. However, these devices are complex, and specially trained diabetes care personnel are needed to teach patients how to use them.

Technology of CGM. All commercial CGM devices measure glucose from the interstitial subcutaneous tissue. The sensors generally are stable and functional for 3 to 7 days. The system consists of a transmitter which provides the energy for the sensor and facilitates the transfer of the glucose signal to a receiver. The sensor takes time to generate an accurate signal after insertion, and it is important to recalibrate if the sensor is detached for any reason. Currently there are four such CGM devices (Table 1).

All sensors can be programmed for low and high alarms that are set by parents, and all indicate that action must be taken. Glucose values are recorded every five minutes. Sensors measure a wide range of glucose levels, from 20mg/dl to 500 mg/dl. All involve wireless transmission of data to a receiver.

Accuracy of the sensor data. Because the glucose levels that these sensors measure are of the interstitial tissues, readings from the BG meter differ from the sensor glucose levels by 8mg/dl to 18 mg/dl. There is a time lag between measurements—the sensor value reading lagging behind the meter reading.[6] Whenever rapid or wide fluctuations in blood glucose levels occur, there is an even greater difference between the sensor value and finger stick BG value. For these reasons, calibration should not be performed following meals or during hypoglycemia. Sensors should be calibrated using the capillary levels obtained on the glucose meter a few times over a 24-hour period.

The most useful information that the sensor provides is about trends of glucose excursions, which can be used to make appropriate changes in insulin dosing, food intake and physical activity. Sensors have been tested in studies to test patient acceptance,[9] ability to lower HgbA1C[7] and ability to detect hypoglycemia.[8] A large study is underway to test the effect of these sensors on diabetes control.

Sensor and hypoglycemia. Avoidance of clinically significant hypoglycemia is important because low blood glucose levels have negative effects on health. CGM has helped in identifying and reducing the frequency and degree of hypoglycemia. To detect low BG values, the sensor alarm can be set for specific glucose levels and for the glucose level rate of fall. Thus, based on the rate of fall of glucose, potential hypoglycemia can be prevented. Patients who use the sensor feel that it helps decrease the frequency of hypoglycemia and gives them additional information for adjusting insulin doses. The CGM devices store all blood glucose data and include software that allows the information to be downloaded. This information can be inter-phased with the insulin delivery history from an insulin pump and used to make insulin dose adjustments.

Table 1. Continuous Glucose Monitoring Devices

Features	Medtronic MiniMed Guardian	Medtronic MiniMed Real Time Insulin Pump	DexCom	Freestyle Navigator
Communication	Wireless receiver	Insulin pump receiver	Wireless receiver	Wireless receiver
Distance	6 feet	6 feet	5 feet	10 feet
Sensor life	3 days	3 days	7 days	5 days
How BG data are obtained	Manual or linked to glucometer	Same as the Guardian	Cable link to One Touch Ultra or manual	Freestyle meter built into the receiver
Number of calibrations	2 to 4 / day	2 to 4 /day	2 to 4 /day	4 / 5 days
Predictive high/ low alarm	Yes	Yes	Yes	Yes
Range of glucose display (mg/dl)	40 to 400	40 to 400	40 to 400	20 to 500
Display updated	Every 5 minute	Every 5 minutes	Every 5 minutes	Every 1 minute
Events that can be entered	Insulin, meals, exercise	Insulin, meals, exercise	None	Insulin, meals, exercise, health, other
Computer software	Insulin, meals, exercise, Carelink personal software	Carelink personal software integrates with Paradigm pump download	DexCom DM, consumer data manager DM 2, professional data manager	Freestyle CoPilot software

CGM is an excellent tool for patients with diabetes who are motivated and who want to optimize their control. It gives peace of mind to parents of young patients who have frequent episodes of hypoglycemia or have hypoglycemia unawareness. More experience is needed to establish its efficacy in improving diabetes control. Its use is limited to centers that have trained personnel who can teach patients to use it.

NEWER INSULIN DELIVERY SYSTEMS

Insulin delivery is now most commonly performed using insulin pens and pumps. More and more children and their families are opting for use of these alternate methods of insulin delivery over conventional insulin syringes. Pens and pumps free the patient from the need to carry and store the paraphernalia needed for traditional modes of insulin injection.

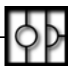
Insulin Pens

There are both pre-filled disposable and reusable pens with pre-filled cartridges. An advantage of insulin pens is that they do not need refrigeration and are accepted well by patients, especially teenagers, as the device truly looks like a pen; thus, the stigma of using a syringe and needle is avoided. Because of the pens' easy use, caretakers other than parents (school personnel, baby sitters) can be taught to be comfortable in dialing up the insulin dose.

Insulin Pumps (Continuous Subcutaneous Insulin Infusion [CSII])

The advent of insulin pumps has revolutionized insulin delivery. Continuous subcutaneous insulin infusion mimics physiological insulin secretion by providing basal insulin to inhibit glucose production by the liver. Mealtime boluses can be determined by a pre-programmed algorithm and delivered by manually pressing a button on the pump. Since its introduction in the 1970s, there have been many technological advances in delivery of the insulin with the pumps. The pumps currently in use are called "smart pumps," as they have programmable features that are built-in and enable the patient to tailor their insulin delivery more precisely to achieve fine tuning of blood glucose levels. Pumps have greatly facilitated diabetes management, allowing a more flexible lifestyle than was dictated by fixed insulin regimens, in which the timing and composition of meals had to coincide with peak action of insulin to avoid hypoglycemia and fluctuations in blood glucose levels. This single modality has made living with diabetes easier.

Technology. All pumps have an insertion set, in which a plastic cannula is inserted into



the subcutaneous (SQ) tissue using a needle guide. In general, the cannula is connected to the pump by flexible tubing. The sole exception is the Omnipod pump, in which no tubing is needed, as the catheter is part of the Omnipod itself and inserts directly into the SQ tissue. All pumps share many basic features, with some minor differences:

- Compact and easy to wear
- Programmable dosing calculators for carbohydrates and for correction of high BG
- Alarm settings for battery life and insulin volume
- Child safety locks
- Many types of boluses to suit the meal content
- 24-hour technical support
- Bolus history tracking

Additional features of the newer smart pumps include:

- Automatic communication with the BG meter
- Bolus onboard feature to avoid stacking (cumulative effect) of insulin
- Food data information and capability to add new foods
- Waterproof feature
- Variable basal patterns
- Communication with CGM
- Software for downloading all information

Commercially available insulin pumps are shown in Table 2.

Advantages of using CSII. Rapid acting insulin analogues are more physiological and more effective in controlling meal-related hyperglycemia than are older insulins.[10] Rapid acting insulin can be given using multiple doses of insulin (MDI) per day to cover meals. This at times may create problems with acceptance and adherence. One of the main barriers to optimal diabetes control in teens has been the unwillingness to give insulin injections every time they eat.

CSII provides the freedom and flexibility of lifestyle and produces better coping and acceptance of the rigors of daily diabetes care, with improved quality of life and greater adherence to recommendations.[11] Freedom from restrictions of timing and number of meals is an important issue among teenagers. Use of insulin pumps eliminates that restriction and provides greater satisfaction with diabetes management.[12] As glucose variability is lessened with basal rate adjustments, the fear of hypoglycemia diminishes, and may even be eliminated.

Metabolic advantages. CSII not only provides improvement in patient satisfaction and better acceptance of diabetes, but offers better glycemic control. Reduction of serious hypoglycemia associated with seizures and coma is significant, from 37% to 24% (Figure 1). CSII also has improved meal-related hyperglycemia and decreased the frequency of post-prandial hyperglycemia. Because HgbA1C is the standard measure of diabetes control, the effect of CSII on HgbA1C has been studied extensively. Improvement of HbgA1C has been shown in studies comparing MDI with CSII. At baseline (Figure 2) the levels were not significantly different. At 16 weeks, the CSII (pump) group had significantly lower levels compared to baseline.

Glucose variability and CSII. Glucose variability has been receiving more attention as an important indicator of metabolic control. Great variability in BG causes oxidative damage to the endothelium, and hence, leads to long-term morbidity. This effect is considered to be as damaging as exposure to hyperglycemia.[13] With CSII, insulin delivery can be adjusted to decrease or even to eliminate this variability. To reduce the degree or frequency of blood glucose variability further, it is now possible to incorporate the data from some CGM devices into the pump's memory, with the goal of having the pump adjust the settings based on the BG numbers and trends. This adjustment is done by the use of algorithms. One such algorithm was developed by the DirecNet study group.[14] DATA (*D*irecNet *A*pplied *T*reatment *A*lgorithm) provides guidelines that help the CSII/CGM

Table 2. Comparative Features of Insulin Pump Varieties

Features	Animas IR2020	Medtronic Paradigm	Accu-Chek Spirit	Insulet Omnipod	Sooil/USA diabecareIIS
Battery life	6 wks to 8 wks	3 wks	3 wks	4 wks	8 to 10 wks
Reservoir size	200 units	300 units	176 or 300 units	200 units	300 units
Basal increment	0.025 U	0.05 U	0.05 U	0.05 U	0.01 to 0.1 U
Bolus increment	0.05 U	0.05 U	0.1 U	0.05 U	0.1 U
Carbohydrate and correction dosing	Manual /Bolus Calculator	Manual /Bolus Wizard	Manual /Bolus Calculator	Bolus Calculator	Manual /Bolus Calculator
BG meter link	Manual entry Link with Ultra Ping	Manual entry Link with Ultra	Link with Ultra		

Figure 1. Frequency of Hypoglycemia (Low Blood Glucose) Events

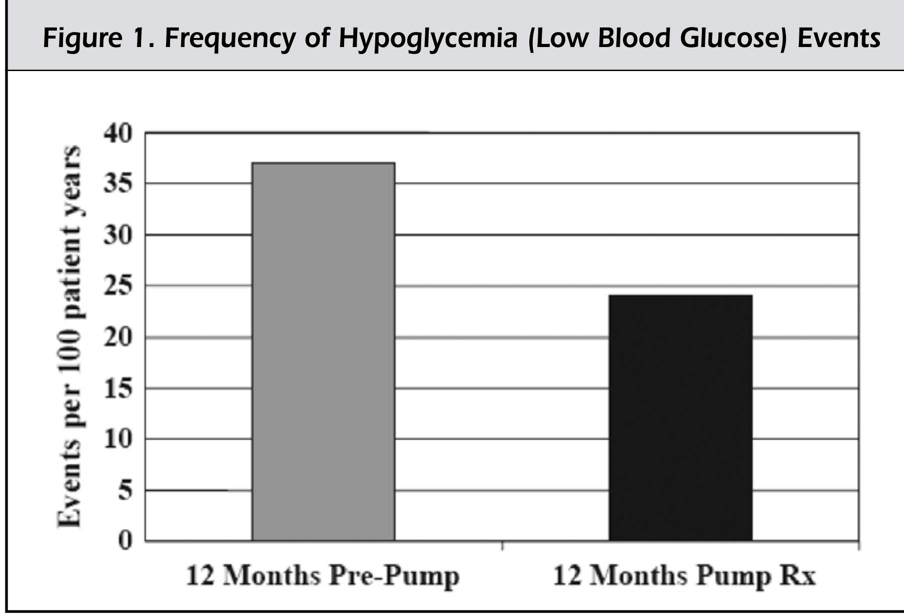
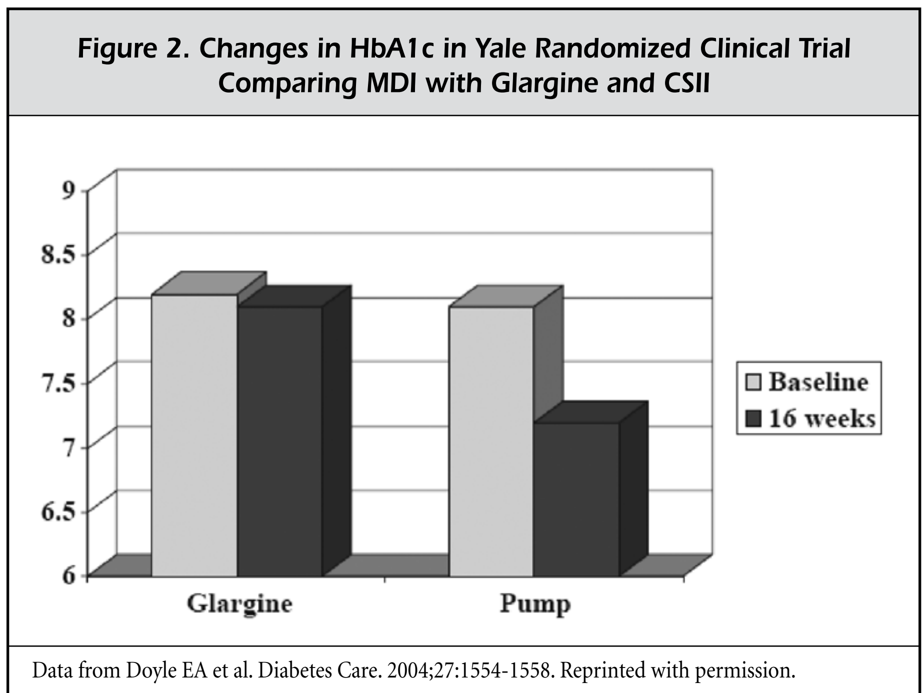


Figure 2. Changes in HbA1c in Yale Randomized Clinical Trial Comparing MDI with Glargine and CSII



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user to modulate the pump settings for more accurate insulin dosing and to reduce blood glucose variability.

CLOSED LOOP SYSTEM (ARTIFICIAL PANCREAS)

With technological advances, combining of CGM and the newer programmable external pumps, along with a built-in algorithm that automatically adjusts the insulin delivery based on BG readings from the sensor, constitutes the "closed loop" or "artificial pancreas."[15] This insulin delivery system more closely reproduces normal beta cell function in achieving near normal glycemia. However, as the glucose readings obtained from CGM lag behind blood glucose concentrations, and subcutaneous insulin delivery lags behind the physiologic portal delivery route, the ability of the closed loop system to lower post-prandial hyperglycemia is not yet ideal. However, it is superior to other currently available alternatives. The future of this concept of closed loop artificial pancreas is being explored further under the JDRF Artificial Pancreas Project.

SUMMARY

The discovery of insulin dramatically changed management of diabetes. Since then many new modalities have improved both short-term and long-term diabetes care. Newer technological strategies and tools have not only made living with diabetes easier, but have improved metabolic outcomes. In the future, further refinement of glucose monitoring and insulin delivery systems will pave the way for improved access of the latest technologies to all patients with diabetes, the ultimately leading to development of a true artificial pancreas.

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Feature Article

Community Resources for Promoting Youth Nutrition and Physical Activity

Kelly R. Moore, Melissa K. McGowan, Karen A. Donato, Sobha Kollipara, and Yvette Roubideaux

ABSTRACT

Childhood obesity is a national public health crisis. The National Diabetes Education Program (NDEP), the National Institutes of Health and Kaiser Permanente have developed community tools and resources for children and families to lower their risk for obesity through healthier, active lifestyles. The authors describe innovative practices and community mobilization case studies from the NDEP "Move It! and Reduce Your Risk for Diabetes" *program and the NIH* **We Can!™** *- Ways to Enhance Children's Activity and Nutrition, and programs from Kaiser Permanente for the promotion of healthier lifestyles for children and families. Replication of these creative programs can be modified to be implemented in communities throughout the United States.*

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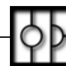
INTRODUCTION

Calling the prevention of childhood overweight and obesity a "national health priority," the Institute of Medicine in 2005 outlined a series of recommendations to stem this epidemic.[1] One of those recommendations called on "local governments, public health agencies, schools and community organizations [to] collaboratively develop and promote programs that encourage healthful eating behaviors and regular physical activity, particularly for populations at high risk of childhood obesity. Community coalitions should be formed to facilitate and promote cross-cutting programs and community wide-efforts."[1] In addition, the U.S. Department of Health and Human Services (DHHS) *Steps to a Healthier US* initiative aims to encourage state programs and community efforts "to prevent and reduce the costs of disease, improve people's lives and promote community health and wellness."[2]

To meet this national crisis of childhood obesity and the increasing incidence of childhood type 2 diabetes, the National Diabetes Education Program (NDEP) has developed community tools and resources for children and families to lower their risk for diabetes through healthier, active lifestyles. NDEP, a joint initiative of the U.S. Department of Health and Human Services, Division of Diabetes Translation of the Centers for Disease Control and Prevention (CDC) and the National Institute of Diabetes and Digestive and Kidney Disease (NIDDK) of the National Institutes of Health (NIH), was created in 1997. Involving over 200 public and private partner organizations, NDEP and its partners share a joint mission of improving the treatment and outcomes of people with diabetes, promoting the early diagnosis of diabetes and preventing or delaying the onset of diabetes in those at highest risk, and translating the results of clinical trials to the

Kelly R. Moore is an associate professor, Colorado School of Public Health Centers for American Indian and Alaska Native Health, University of Colorado Denver, Aurora, CO 80045; E-mail: kelly.moore@ucdenver.edu. Melissa K. McGowan is a public health advisor, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD 20892; E-mail: mcgowanm@niddk.nih.gov. Karen A. Donato is a coordinator, Overweight and Obesity Research Applications, National Heart, Lung, and Blood Institute, Bethesda, MD 20892; E-mail: donatok@nhlbi.nih.gov. Sobha Kollipara is director, Pediatric Endocrinology and Diabetes, Kaiser Permanente Roseville, Roseville Medical Center, Roseville, CA 95661; E-mail: sobha.kollipara@kp.org. Yvette Roubideaux is an assistant professor, Department of Family & Community Medicine, College of Medicine, The University of Arizona, Tucson AZ 85716; E-mail: yvette.roubideaux@gmail.com.



general public and to health care professionals in a clinically useful way.

Following is a description of innovative practices from NDEP, NIH and Kaiser Permanente for mobilizing community resources for the promotion of healthier lifestyles for children and families. The NDEP approach included here is the NDEP's "*Move It! And Reduce your Risk of Diabetes*" school kit, an NDEP program that encourages incorporation of physical activity into everyday life.

Another community based effort of the NIH, ***We Can!™*** - *W*ays to *E*nhance *C*hildren's *A*ctivity and *N*utrition, was developed to help community organizations assist children and families to maintain a healthy weight. Launched in 2005 by the National Heart, Lung and Blood Institute in collaboration with the National Institute of Diabetes and Digestive and Kidney Diseases, the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development, and the National Cancer Institute ***We Can!™***, it is a synergistic movement of communities across the nation to improve family food choices, increase physical activity and reduce screen time in children ages 8-13 years old.

Kaiser Permanente also strongly advocates for the promotion of healthier lifestyles to reduce obesity related morbidity, especially in school settings. Under its campaign "Thrive," Kaiser Permanente has developed *Educational Theatre Programs* to educate children and teens on health issues such as nutrition and physical activity through drama, music, and humor. *Healthy Eating Active Living (HEAL)* is another example of a Kaiser Permanente community-based health promotion program. *HEAL* focuses on support for low income communities to develop healthy eating and exercise habits.

PROGRAM DESCRIPTIONS

Move It! And Reduce Your Risk of Diabetes

The NDEP *Move It! And Reduce Your Risk of Diabetes* school kit is a diabetes awareness and physical activity promotion campaign targeting American Indian/Alaska Native youth ages 12–18 years. The kit was developed by the NDEP American Indian/Alaska Native Workgroup as a part of its *Move It!* campaign. The original campaign was a series of posters featuring American Indian/Alaska Native teens engaged in different types of physical activity. The campaign was developed through a social marketing process to ensure that the target audience would be responsive to the educational messages. After a review of focus groups held with American Indian/Alaska Native teens, the workgroup discovered that a physical activity message was more likely to be effective than a message focusing on nutrition. After successful dissemination of the *Move It!* posters, the workgroup decided to develop a school kit to broaden the reach of the posters and to find a way to engage American Indian/Alaska Native youth and schools in diabetes and obesity prevention activities.

The *Move It!* school kit was designed to empower Native youth to create their own physical activity and diabetes awareness strategies and program plan, with facilitation by a teacher, school counselor, or coach. The kit contains a cover letter for the school principal with instructions, tips on getting started, a fact sheet about type 2 diabetes in youth for students and one for teachers, *Move It!* campaign posters, a resource list, a newsletter, a template news release/newsletter article, a flyer with instructions for ordering pedometers, information on other NDEP materials, and a CD of all the materials for customization. Schools are encouraged to implement activities with their students to create awareness about diabetes and to encourage physical activity. Schools also are encouraged to customize the posters with pictures of teens from their schools and their school logos.

The *Move It!* school kit has been disseminated through mass mailings to three types of schools identified as having American Indian/Alaska Native middle and high school students: (1) tribal schools; (2) Bureau of Indian Education schools; and (3) public schools with a Johnson-O'Malley (JOM) program, a supplemental education program for American Indian/Alaska Native students from age three years to 12th grade, to meet the unique cultural needs of these students as authorized by an Act of Congress in 1934 and contracted by the Department of the Interior. In addition, NDEP also disseminated the kit to American Indian/Alaska Native health programs, youth organizations and media outlets and encouraged them to work with their local schools.

The *Move It!* campaign was enhanced by a grant program for schools that was developed by the Association of American Indian Physicians (AAIP) with funding from the Office of Minority Health (OMH), U.S. Department of Health and Human Services. AAIP is a national minority organization that is funded by NDEP to disseminate their materials to American Indian and Alaska Native communities throughout the country. AAIP used this funding to award one-year mini-grants of $7,500 to approximately 25 schools over this three-year initiative for the purpose of implementing activities to promote the *Move It!* campaign. Eligible schools included tribal schools, Bureau of Indian Education schools and public schools with a Johnson-O'Malley program. Under these grants, the schools implemented a variety of activities including summer programs promoting physical activity and healthy eating, purchase of sports and exercise equipment, community health fairs, field trips and other educational and awareness activities. Grantees also received training and technical assistance on program development and evaluation. Reported positive outcomes included improvements in knowledge regarding diabetes and healthy food choices, decreased weight of participants, and increased participation in physical activity by students engaged in this program. The program also resulted in changes in school lunch menus and school vending machine policies, resulting in healthier food and drink options in school settings.[4]

COMMUNITY MOBILIZATION CASE STUDIES

Move It! - Case Studies

During the *Move It!* grant program, schools implemented a wide variety of

diabetes awareness activities and programs that encouraged physical activity. Often these activities benefited the community in ways not initially anticipated. Examples of community engagement and resource mobilization are discussed below in three case studies of *Move It!* programs.

Case Study 1: Hannahville Indian School in Wilson, Michigan

Hannahville Indian School, also known as Nah Tah Wahsh (Soaring Eagle) School, is a charter school serving approximately 165 K-12 students on the Hannahville Potawatomi Reservation of the upper peninsula of Michigan. Students and teachers from the Hannahville School learned an important message of hope from the *Move It!* materials—that it was possible to reduce their risk for type 2 diabetes. Recognizing that youth increase their risk for type 2 diabetes by becoming more overweight and inactive, Hannahville focused on making changes in the school cafeteria and the school vending machines and increasing physical activity opportunities for their students. The school board accepted a healthier lunch menu of limiting portions, serving chocolate milk only on Fridays and adding fresh fruits and vegetables to the menu. A policy was proposed to change the amount of carbohydrates supplied during school functions, resulting in fewer sweets and healthier options for school classroom parties. The school also limited pop machine use to after school hours and added water as a vending machine option. In addition, Hannahville offered a two-week basketball camp, partnered with the YMCA to have certified fitness instructors brought to Hannahville Reservation, and implemented a walking program.

The grant also was used to hold community health fairs where distribution of American Indian/Alaska Native NDEP materials at community events increased the reach of their *Move It!* program beyond the grounds of the school.

Case Study 2: Pine Point Public Schools in Ponsford, Minnesota

Pine Point Public Schools serve students of the White Earth Indian Reservation of Minnesota. The immediate relevance of the *Move It!* school kit was noted by the Pine Point Middle School superintendent because diabetes is so pervasive among American Indians in their community. At the time, no organized sports were offered in the school, and few of the students had ever been camping. With the *Move It!* focus upon physical activity, the Pine Point *Move It!* Club traveled to the Western North Dakota Badlands for a five-day camping and hiking trip. Students planned the transportation, educational meetings with a naturalist at the park and meals. The students conserved funds by buying food through their school food service, including maple syrup from tribally owned maple sugar trees. Cooking and eating a healthy breakfast each day was an important lesson learned for these students, who rarely ate breakfast at home. The students hiked at least five miles every day and, according to staff, learned to appreciate the benefit of such an increase in physical activity. Other important lessons learned by the students included gaining self-confidence in trying new things and acquiring new knowledge on the importance of healthy eating and increased physical activity in reducing one's risk for diabetes.

Case Study 3: Davenport High School in Davenport, Oklahoma

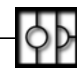
Davenport is a small rural community in north central Oklahoma, home to part of the Sac and Fox Nation of Oklahoma. The Asakiwaki (Sac) and Meshkwahkihaki (Mesquakie/Fox) are Algonquin-speaking peoples originally from the northeastern United States. Asakiwaki means *"people of the yellow earth"* and Meshkwahkihawi means *"people of the red earth."* The Davenport Indian Club includes students from the Sac and Fox Nation and other Oklahoma tribes. Led by a Miami Indian Nation of Oklahoma student, the Club asked the school board for a donation of five acres of land near the school as part of their *Move It!* grant planning for a quarter-mile running and walking track for the school and community of Davenport. When the grant was awarded, the school board followed through on their donation pledge. Grant funding was used to purchase asphalt, and the Lincoln County Commissioner donated all the labor for the track project. Other community donations supplied additional materials and equipment needed to complete the track and make it handicapped accessible.

Customizing the *Move It!* posters to include pictures of Davenport Indian Club students was an important community mobilization effort. The students disseminated the customized posters and flyers on diabetes awareness, and prevention tips and suggestions, outside the county courthouse and throughout the county. Raising community awareness about diabetes inspired community support for the track.

With completion of the track, the Davenport Running Club was formed as an after school activity group. Students were encouraged to set physical activity goals and to attend a running club meeting once a month. Students now use the track for training for marathons and serve as role models for not only their fellow classmates, but for their grandparents as well. The Davenport Indian Club received a citation from the Governor of Oklahoma for its commitment to preventing diabetes in their community.

The NDEP *Move it! And Reduce Your Risk of Diabetes* Campaign was developed to help create awareness about the growing problem of diabetes in American Indian/Alaska Native youth and the importance of physical activity in reducing risk factors for diabetes. The campaign has been disseminated widely in American Indian/Alaska Native health programs and schools, and the kit has been an NDEP product that has filled a void in teaching schools how to implement healthy activity programs, with demonstrated success in helping local schools and communities implement diabetes prevention activities for youth.

With its focus on directly encouraging youth to develop activities, the school kit has resulted in a diverse set of culturally- and community-relevant diabetes prevention activities that promote physical activity. The *Move It!* grant program gave schools a small amount of funding, but resulted in



activities that impacted both the schools and the communities in which they reside. The progression of the *Move It!* campaign, from posters delivering a public health message developed through a social marketing strategy, to a focused dissemination of tools and resources to schools, and finally, through a grant program that provided needed resources for implementation of school and community activities, is a model of a successful process for dissemination of similar public health messages to other communities. The *Move It!* campaign is an example of how multiple strategies are needed to engage and mobilize communities to help address prevention of complex diseases such as diabetes and obesity.

WE CAN!™ – WAYS TO ENHANCE CHILDREN'S ACTIVITY AND NUTRITION

In response to the childhood obesity public health crisis, the National Heart, Lung and Blood Institute in collaboration with the National Institute of Diabetes and Digestive and Kidney Diseases, the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development, and the National Cancer Institute launched ***We Can!™*** in 2005 to improve family food choices, increase physical activity and reduce screen time in children ages 8-13 years old. The program is designed to be a flexible, turnkey program that engages the entire community to help children maintain a healthy weight. Programs are being run in 12 different settings ranging from local park and recreation departments and schools, to hospitals, health centers, and public health departments. ***We Can!™*** offers parents and families, health care providers, community organizations, and civic leaders some science-based programmatic resources, curricula, tips, and fun activities to encourage healthy lifestyles in children.

To reach its priority audiences of children, parents, and primary caregivers, ***We Can!™*** works with community sites around the country to take an active role in creating healthier environments that promote a healthy weight. Community organizations and groups that become ***We Can!™*** sites receive materials, training, and technical assistance from NIH so they can implement programs for parents and youth, conduct community events, engage the media, and create partnerships. Programs and activities focus on three critical behaviors: improved food choices, increased physical activity, and reduced screen time. The three components of ***We Can!™*** that focus attention to these behaviors include community outreach, national partnerships, and media outreach.

The community outreach component focuses on *people*, *programs*, *partnerships*, and *public visibility* (4*Ps)*. It consists of engaging key stakeholders within the community to implement programs both for youth and parents in a variety of settings, to conduct community events, to engage partners, and to work with the media for public visibility. These elements are designed to be implemented concurrently to help youth achieve the ***We Can!™*** behavioral objectives, improve the capacity of parents and family caregivers to help their children achieve those objectives, and to build community support around promoting healthier nutrition choices and increasing physical activity levels.

WE CAN!™ – YOUTH PROGRAMS

To reach the youth audience, ***We Can!™*** communities can choose from three evidence-based curricula and programs, including CATCH Kids Club, Media-Smart Youth: Eat, Think and Be Active!, and Student Media Awareness To Reduce Television (S.M.A.R.T.).

CATCH Kids Club: The Child and Adolescent Trial for Cardiovascular Health (CATCH) was a National Heart Lung and Blood Institute (NHLBI) funded study to create a school health education curriculum encouraging healthy behavior in children in grades K-5. Based on the study, CATCH Kids Club is a curriculum that uses a coordinated approach to help children achieve healthy dietary and physical activity behavior in after school or summer camp settings. It consists of three programmatic elements, a nutrition education component, a physical activity component, and a snack component.

Media-Smart Youth: Eat, Think and Be Active: Media Smart-Youth, developed by the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development, is a 10-lesson curriculum that teaches youth ages 11-13 to think critically about the connections between media and health. The program uses nutrition and physical activity examples to help youth learn about these connections and build their media analysis skills. The curriculum concludes with a Big Production—an opportunity for participants to use what they have learned to create a media project designed to motivate other young people to take action for better nutrition or increased physical activity.

Student Media Awareness to Reduce Television (S.M.A.R.T.): S.M.A.R.T. is a classroom-based curriculum for third-grade and fourth-grade students designed to motivate children to reduce their television watching and video game usage. Based on research conducted at Stanford University, the curriculum is intended to be used over the course of the school year and includes all lesson plans and tools needed to implement the program.

WE CAN!™ – PARENT PROGRAM

To provide the information and tools that parents and caregivers need to help their children maintain a healthy weight, NIH developed ***We Can!™*** Energize Our Families: Curriculum for Parent and Caregivers. Available as four 90-minute sessions or six 60-minute session, this curriculum provides dynamic lessons that stress the importance of energy balance in maintaining a healthy weight. Each interactive session focuses on helping participants learn essential skills that can assist families with increasing access and availability of healthy foods and making healthful food choices, becoming more physically active, and reducing recreational screen time. Participants are encouraged to try new nutrition and physical activity tips with their families between lessons, and they are asked to share their experiences with the group.

WE CAN!™ – COMMUNITY EVENTS AND PROJECTS

To complement the lessons learned through the youth curricula and the parent program, ***We Can!™*** also provides materials to help increase greater community awareness of the importance of maintaining a healthy weight for children through healthy nutrition and increased physical activity. ***We Can!™** Energize our Community: Toolkit for Action* provides information around the 4*P*s noted previously to help community organizers and leaders plan and implement ***We Can!™***. Tips, materials, and planning documents are included in the toolkit.

WE CAN!™ – CASE STUDIES

In June 2005, ***We Can!™*** was launched in 14 pilot communities for the period of one year. Each of those community sites conducted parent and youth programs, as well as community events. Examples of community engagement from three pilot sites are provided below.

Case Study 1: We Can!™ – Boston Steps

Boston Steps is a community mobilization effort of the Boston Public Health Commission to address the burden of chronic diseases, including obesity and diabetes, in high-risk communities in Boston. *Boston Steps*, funded by the Center for Disease Control and Prevention's (CDC) *Steps to a Healthier US Initiative*, joined ***We Can!™*** as one of the 14 original pilot sites. In addition to the ***We Can!™*** parent program, *Boston Steps* collaborated with several partners, including the YMCA of Greater Boston, the Boston Organization of Nutritionists and Dietitians (BOND) of Color, community health centers and two Boston Public schools, to promote and implement the programs and to recruit parents in an effort to enhance their outreach to parents. Through partner activities such as health fairs, summer camp fairs and school programs, *Boston Steps* was able reach out to parents and promote participation in ***We Can!™***. Partners provided facilities for the programming and child care support for parents attending the programs. In addition, partners offered incentives, including discounted family memberships to the YMCA, to parents who completed the parent program.

To reach diverse audiences, *Boston Steps* and BOND of Color culturally adapted lessons to reach parents in the African American and Caribbean communities. In addition, the parent program was translated into Spanish and implemented at several local schools. The Spanish language classes were extremely popular, and several schools requested that additional classes be scheduled. *Boston Steps* has continued to promote ***We Can!™*** activities through its partner organizations, including reaching out to all Boston YMCAs to build capacity for conducting ***We Can!™*** parenting classes in both English and Spanish. In 2007, the Mayor of Boston proclaimed November 29, 2007 as ***We Can! day*** and Boston joined the program as a ***We Can!*** city.

Case Study 2: Partnering for Youth Program Success in Las Vegas

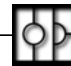
The ***We Can!™*** Southern Nevada site is a collaboration among the University of Nevada-Las Vegas (UNLV) Department of Nutrition Sciences, City of Las Vegas Department of Leisure Services and the City of Henderson Department of Parks and Recreation. As part of their programming, the Southern Nevada site implemented the Media-Smart Youth: Eat, Think and Be Active! Curriculum (MSY), reaching about 40 students. The MSY programming concluded with participants developing a television public service announcement (PSA) that was shown on local television networks and in a local movie theater for several weeks. The sites formed a partnership with the UNLV television station (UNLV-TV), which provided staff and production assistance for the Media-Smart Youth PSA. The Dairy Council of Utah and Nevada provided financial assistance to support the Media-Smart Youth programming. In addition, the Mayor proclaimed Las Vegas to be a ***We Can!*** city in November 2007.

Case Study 3: Reaching the Community in South Bend, Indiana

As another ***We Can!™*** pilot site, the South Bend Parks and Recreation Department, reached more than 10,000 community members in 2005-2006 through extensive community outreach programs that supported ***We Can!™*** parent and youth program messages. Through their community events, the South Bend Parks and Recreation Department also received media coverage and established partnerships for its ***We Can!™*** programs. To kick off its ***We Can!™*** programming, the site held a summer event that began with a press conference, followed by a range of activities and entertainment including physical activity games for children, food spectrum and portion distortion charts, and healthy nutrition tips. The site partnered with a local supermarket that provided food for a local chefs' association's healthy snack demonstration during the event. The South Bend Parks and Recreation Department leveraged these partnerships to continue similar food demonstrations at other community events throughout the year, including a Kid's Triathlon. For the triathlon, 600 children ages 5 to 13 participated in a 25-yard swim, a 1.3 mile-bike ride, and a half-mile run. More that 2,400 people watched the event, at which there were also healthy food, onsite massages, and healthy snack demonstrations. The South Bend Parks and Recreation Department also used these community events as an opportunity to recruit for the ***We Can!™*** parent program.

These three case studies highlight the utility of engaging communities to support and reinforce the behavior messages conveyed through the ***We Can!™*** program. The Boston, Las Vegas and South Bend sites also demonstrate effective use of the 4*P*s of ***We Can!™*** community outreach.

By culturally adapting the ***We Can!™*** parent program, the Boston site was able to reach a diverse group of parents and caregivers with culturally relevant programs. Partnerships with local YMCAs and schools helped with public visibility and recruitment, and subsequently, led to a demand for additional programs. By forging media partnerships, the Las Vegas site was able to implement the MSY program with youth who created a television PSA that garnered public visibility for the program when the



PSA was run on local television networks and in a local movie theater. Through its series of community events, the South Bend site was able to leverage partnerships with a supermarket and a chefs' association to provide healthy snack demonstrations for youths and adults, while simultaneously recruiting participants for its programs and receiving media coverage.

Since ***We Can!™*** was launched in 2005, the program continues to engage communities, large and small, throughout the country and around the world. ***We Can!™*** programs are now being run in more than 1,000 communities in all 50 states, the District of Columbia and 11 foreign countries, with new sites joining the program weekly.

KAISER PERMANENTE SCHOOL BASED PROJECTS FOR OBESITY PREVENTION

Kaiser Permanente Sacramento has been a strong advocate for promotion of healthier lifestyle habits in schools to reduce childhood obesity related morbidity. A priority has been established to promote obesity prevention activities for youth by supporting programs that increase physical fitness and healthy food choices. Kaiser Permanente is a part of the Healthy Community Forum, established in 1995 to assess the needs of the community, and has partnered with the other major health care systems on the community needs assessment. Since 2004, Kaiser Permanente has supported this need by assisting and providing support for local schools and community groups to develop and implement programs that improve physical fitness levels and healthy food choices for children. These programs include:

• *Healthy Eating Active Living (HEAL)* programs throughout California that work to make healthy foods readily available and physical activity a part of daily life. Its focus is on support for low income communities to improve healthy eating and increase active living. This program has received praise from the Institute of Medicine (IOM).[5]

• *Soil Born Farm Urban Agriculture Project, Looking through the Fence:* Connecting Food, Health, and the Environment at Jonas Salk High Tech Academy, and Soil Born Farm's Rancho Cordova Healthy Youth Partnership.

• *Explorit Science Center* that expanded "Food in your World," an interactive program in Sacramento, Yolo and Placer counties.

• *The FEED Coalition* (Food Education Equity and Diversity) "EAT! from the Garden" Cooking Kitchen, that provides cooking classes to almost 900 students.

• *California International Marathon's Youth Fitness Program* which teaches lifelong fitness habits to elementary school students over an eight-week period in the fall.

• *The Educational Theatre Programs* that educate children and teens about health issues such as nutrition and physical activity through drama, music and humor. This program is provided without charge to school systems and community organizations in three counties and has reached more than 2.5 million students since its creation in 1987.

CONCLUSION

Research has shown that engaging in community wide health education campaigns can have an impact on increasing healthy behaviors, such as physical activity.[1,3] Replication of the creative programs described above can be modified to be implemented in communities throughout the United States.

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*Continuing Education Questions

Self-study Questions for Continuing Education Hours

AAHE, as a multiple-event provider through The National Commission for Health Education Credentialing, Inc., provides this self-study opportunity in the *American Journal of Health Education*. Category 1 continuing education contact hours (CECH) are awarded for each article. After completion of six articles, a certificate is sent to the Certified Health Education Specialist. Each article is worth 1 CECH. Please keep a copy for your records. There will be no notification from AAHE until you complete six CECH or if you fail to score 80% on each article. You may either mail or fax your response form to AAHE at the address below.

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Event Code: 9-2009

For Continuing Education Contact Hours Article

Role of Health Educators in Assisting Youth and Adolescents with Diabetes

Congruent to Responsibility VII: Communicating Health, Health Education Needs, Concerns and Resources

1. Insulin has _____dimensions of importance to successful management of diabetes.

a. 1
b. 2
c. 3
d. 4

2. Most children with type 1 diabetes require multiple injections or they receive their insulin___________.

a. in pill form
b. through an inhaler
c. transdermally
d. through a programmable insulin pump

3. The different types of insulin have been formulated to have ____________onset and duration of action.

a. immediate
b. intermediate
c. long acting
d. all of the above

4. General nutrition recommendations from the United States Dietary Guidelines for American and the United States Department of Agriculture for all youths 4-18 years of age include __________of milk/dairy per day.

a. ½ to 1 cup
b. 1/3 to 1 cup
c. 1-2 cups
d. 2-3 cups

5. Total fat intake should be _________of a child's calories per day.

a. 10-15%
b. 12-18%
c. 25-35%
d. 40-50%

6. Studies indicate that children and adolescents with diabetes eat more _____than recommended.

a. total and saturated fat
b. fruits
c. grains
d. fiber

7. For children with diabetes, contributing factors may be __________.

a. over-insulination
b. snacking
c. excess calorie intake
d. all of the above

8. ___________is the main form of meal planning prescribed for children with type 1 and type 2 diabetes.

a. Carbohydrate counting
b. The food guide pyramid
c. The FDA diabetes diet
d. The ADA diabetes diet

9. Currently it is recommended that children and adolescents participate in at least _________minutes of moderate physical activity most days of the week, preferable daily.

a. 15
b. 20
c. 40
d. 60

10. Lowering hemoglovin A1C (HgbA1C) to an average of ~7% has been shown to reduce micro-vascular and neuropathic complications of diabetes.

a. true
b. false

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Event Code: 10-2009

For Continuing Education Contact Hours Article

Effects of Physical Activity on Diabetes Management and Lowering Risk for Type 2 Diabetes

Congruent to Responsibility VII: Communicating Health, Health Education Needs, Concerns and Resources

1. Adiposity is a major determinant of type 2 diabetes in children and adolescents and is the most relevant modifiable diabetes risk factor in youth.

a. true
b. false

2. _________diabetes mellitus is associated with insulin resistance.

a. type 1
b. type 2
c. type 3
d. type 4

3. Most randomized controlled trials in overweight children and adolescents have shown that _________enhances insulin sensitivity in childhood.

a. family eating patterms
b. physical activity
c. heredity patterns
d. sleep

4. Ferguson observed significantly decreased fasting insulin in seventy-nine obese 7-11 year-old children after _____ month(s) of exercise training.

a. 1
b. 2
c. 3
d. 4

5. The prepubescent child, in particular, is at an increased risk of physical injury due to _______________.

a. a reduction in joint flexibility
b. poor sugar metabolism
c. decrease in growth of long bones
d. decrease in reasoning ability

6. Strength training suggestions for prepubescent children include:

a. climbing trees
b. skipping rope
c. dancing
d. all of the above

7. The American Academy of Pediatrics separates the terms resistance training and strength training from _____________.

a. weight lifting
b. power lifting
c. body building
d. all of the above

8. __________is a clinic-based, interdisciplinary and multilevel weight management program.

a. Empowered Kids
b. Trim Kids
c. Slim Kids
d. Well Kids

9. Increased physical activity in children and adolescents is likely to contribute to _____.

a. establishment of healthy leisure habits over a lifetime
b. improved cardiovascular health
c. both a and b
d. none of the above

10. Physical activity should be sustained, however, throughout adolescence as improvements in _____________are reversed following cessation of exercise.

a. knowledge
b. height
c. insulin sensitivity
d. attitude

Guidelines for Authors

How to Submit a Manuscript

For consideration, contributors must observe the following procedures for submitting manuscripts to the American Journal of Health Education. All submission and review processes are electronic and conducted through JournalSubmit.com (www.journalsubmit.com). JournalSubmit.com is self-explanatory and Web-based. From the JournalSubmit.com home page, click the "Submit a Manuscript" link to log in. If this is the first time submitting a manuscript using JournalSubmit.com the author must register a Username and Password. Authors may track their manuscripts using the Track Manuscript feature and following the on-screen instructions.

Author Guidelines for all Manuscripts

(1) Type manuscripts in *Microsoft WORD*, double-spaced throughout with a 12-point font.

(2) Format the manuscript using the divisions discussed in the following paragraphs.

1. **Title page:** Provide manuscript title only with no author information or institutional affiliation.

2. **Abstract:** *Research Articles* require structured abstracts up to 200 words in length using *italicized* headings identical to the ones listed above. *Feature Articles* require descriptive abstracts up to 200 words in length without headings.

3. **Text:** *Research Articles* and *Feature Articles* can be up to 25 double-spaced pages (~ 6250 words), not including abstract, tables, figures, illustrations, and references. Longer manuscripts will be considered but are subject to editing. *Community, Care Setting, and Worksite Initiatives* and *Commentaries* should be no more than 1500 words long, not including accompanying illustrations and references. Follow the American Medical Association (AMA) 10th edition (2007) Manual of Style for preparing narrative, graphics, and reference portions of manuscripts. Index Medicus abbreviations should be used for all journals that have them. For verification of the abbreviation go to http://www.ncbi.nlm.nih.gov/sites/entrez?db=journals.

   - **Journal references with three or fewer authors:**
     Vitale S, Cotch MF, Sperduto RD. Prevalence of visual impairment in the United States. *JAMA*. 2006;295:2158-2163.

   - **Journal references with four or more authors:**
     Bonilla M-F, Kaul DR, Saint S, et al. Ring around the diagnosis. *N Engl J Med* . 2006;354:1937-1942.

   - **Books:**
     Green LW, Kreuter MW. *Health Promotion Planning: An Educational and Ecological Approach*, 3rd ed. Mountain View, CA: Mayfield Publications; 1999.

   - **Quoted chapter from a book:**
     Baranowski T, Perry CL, Parcel GS. How individuals, environments, and health behavior interact: social cognitive theory. In Glanz K, Lewis FM, Rimer BK, eds. *Health Behavior and Health Education: Theory, Research, and Practice*, 3rd ed. San Francisco: Jossey-Bass; 2002:153–178.

   - **Web site:**
     Centers for Disease Control and Prevention. Prevalence of Overweight and Obesity among Adults: United States, 1999. Available at: http://www.cdc.gov/nchs. Accessed July 1, 2006.

   - **Tables** :
     Tables should use Arabic numbers in sequence throughout the article. Each table should be on its own page at the end of the manuscript. Do *not* submit tables as separate or supporting documents. Reference tables in the text to indicate placement. Include descriptive titles and headings for columns or rows. Avoid unfamiliar abbreviations. General footnotes to tables should be collected as "Note:" or "Notes:" Sequenced letters—a, b, c, etc—should be used in footnotes. Use asterisks (* and/or **) to indicate .05 and .01 levels of significance, respectively.

   - **Figures, Illustrations, Drawings and Photos** :
     These images should be numbered sequentially, captioned, and referenced in the text. They should be appended to the end of the manuscript and *not* submitted as separate or supporting documents. Photos need to be 300 dpi at the size they will be used. For example, an image at 3"x 4" needs to be 300 dpi at that size. If an 8-1/2" x 11" image is submitted, it needs to be 300 dpi at that size. An image that is 300 dpi at 3"x 4" cannot be used at the 8-1/2" x 11" size, because when enlarged it becomes about 76 dpi. Produce photos on the highest "image size" for the camera. Photo credits will be captioned upon request.

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The *Journal* invites manuscripts reporting original research, applications of theory, experiences in practice, historical analyses, and other topics of interest to health educators in universities and other research settings, health departments and community agencies, federal and state agencies, health care settings, worksites, schools, and other venues. Whereas the *Journal* considers *all* manuscripts with implications for health education, data based research reports are preferred. Data based research manuscripts **must** include the following headings: *Background, Purpose*, *Methods*, *Results*, *Discussion*, and *Translation to Health Education Practice*.

Guidelines for Authors Submitting to the Community, Care Setting, and Worksite Initiatives Column

Submissions to the column follow the same on-line submission process at www.journalsubmit.com (Journal ID for submission is AJHE-CCSWI).

Contributions should focus on practical ideas, procedures, and activities originating around the work of practicing health educators in non-school/university settings in the community, including health care facilities and worksites and be a maximum of 1500 words long. Appropriate ideas and procedures can relate to models that guide health educators' work, application of theory, program planning, needs assessment, setting priorities, goals and objectives, interventions, program implementation, resources development and allocation, community organization or mobilization, program evaluation, marketing, or other useful applications of health educator roles, responsibilities, or competencies. Authors should strive for clarity, avoiding extensive literature reviews, lengthy bibliographies, or wordy justifications. Manuscripts must include an unstructured abstract ≤ 75 words in length. The *Journal* welcomes photographs and artwork if they enhance presentation and understanding. The bibliographic style is identical to that used for other submissions to the *Journal*. For further clarification, email Dr. Robert J. McDermott (rmcdermo@health.usf.edu).

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Submissions should follow the same on-line submission process previously described (Journal ID for *Commentaries* is AJHE).

Commentaries are learned opinions that address contemporary issues in health education research, theory, philosophy, pedagogy, or practice. They are ≤ 1500 words in length, not including references. Submissions should have descriptive titles, followed by – *A Commentary* (e.g., *The Future of Health Education – A Commentary*). All submissions are peer-reviewed and are subject to editing. The bibliographic style is identical to that used for other submissions to the *Journal* but should not include an abstract or attachments.

Letters to the Editor

Letters are a maximum of 500 words, not including references. Letters referring to a recent *Journal* article must be received within 4 weeks of publication. Send the letter electronically directly to the Editor (rmcdermo@health.usf.edu). Letters are reviewed by members of the Board of Associate Editors. Receipt of letters and publication decisions will be acknowledged electronically.

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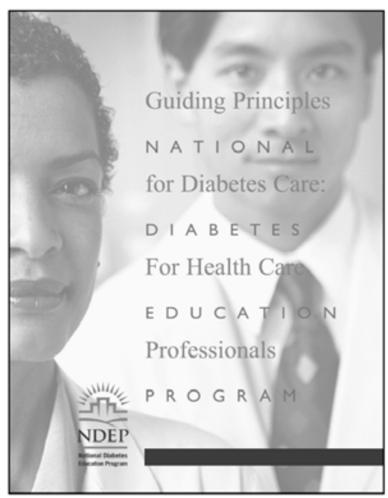
09/09

Updated Resource for Health Educators from the National Diabetes Education Program



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Mark J. Kittleson

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Neighbors United for Health
Wayne W. Westhoff, Jaime Corvin, and Irmarie Virella

Teaching Ideas

Using the Principles of Coordinated School Health to Teach Community Health
Heidi Hancher-Rauch and Lisa Hicks

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Jennifer Thomas and Paul E. Luebbers

"Rewind and Replay:" Changing Teachers' Heterosexist Language to Create an Inclusive Environment
Nicole Aydt Klein and Linda Markowitz

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Tammy Wyatt

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Amy L. Versnik Nowak, Heidi Hale, Jessica Lindholm, and Elizabeth Strausser

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Jane Shimon Terry-Ann Gibson, and Caile Spear

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Annual Subject Index

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