Diabetes and Physical Activity in School

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Children with diabetes should be able to participate fully in school sports and physical education activities, attend field trips, and participate in all team sports. With increased awareness of diabetes and new approaches in its management, participation in physical education is now the norm. Since children spend about seven hours a day at school, it is essential to handle any diabetes-related challenges that arise during the school day, including any that involve exercise.

Understanding the short- and long-term effects of physical activity on diabetes—whether on the playground, in a physical education class, or during team sports—is important for students and their families as well as for school personnel. Knowing the relationship between food, insulin, blood glucose level, and physical activity will greatly reduce the incidence of problems and enhance the benefits of physical activity for students with diabetes.

The Benefits of Physical Activity

Exercise and team sports allow children with diabetes to improve their social skills and gain self-confidence. They may want to participate in team sports such as soccer and Little League baseball, or noncompetitive activities, such as swimming and bicycle riding. Such participation promotes socialization, peer acceptance, and positive self-esteem.

Exercise improves general fitness, strength and cardiovascular endurance and lowers blood pressure and lipids; it also has a profound, and positive, effect on diabetes by improving insulin sensitivity, reducing glucose levels, and reducing long-term morbidity. In children with type 2 diabetes, in particular, exercise helps to decrease fat weight and increase muscle mass, contributing to increased insulin sensitivity.

The Physiology of Exercise

In people without diabetes, increased glucose utilization during exercise triggers an array of homeostatic responses. Insulin secretion typically declines, and concentrations of counter-regulatory hormones that raise blood glucose (glucagon, growth hormone, catecholamines, and cortisol) may rise, increasing liver glucose production. In people who have type 1 diabetes, there is no endogenous source of insulin to modulate, and some counter-regulatory mechanisms may be impaired, particularly after several years of diabetes.

People with diabetes who exercise may have a decreased need for, or better utilization of, exogenous insulin, and thus may enjoy a decrease in diabetes medications — usually, insulin. The acute effect of exercise is increased extraction of glucose from plasma. The blood glucose and hormonal response to exercise depends on the initial blood glucose level, insulin dosage, timing and content of meals/snacks, duration and intensity of the exercise, and fitness level, but mostly on the availability of insulin. Because the person with type 1 diabetes has no endogenous source of insulin, the most common problem encountered during exercise is hypoglycemia (low blood sugar).

A regular exercise program can improve insulin sensitivity, thereby reducing blood glucose levels at times other than during exercise. Likewise, in people with type 2 diabetes, regular exercise can reduce insulin resistance and improve glucose tolerance.

Challenges of Physical Activity

Hypoglycemia

Students with type 2 diabetes who manage the disease by meal planning and physical activity are not at risk for hypoglycemia while exercising. Those with type 2 diabetes who use insulin or some other hypoglycemic drug are at risk for hypoglycemia, and the precautions necessary for students with type 1 diabetes apply to these children.

Hypoglycemia in children with type 1 diabetes is frequently brought on by physical activity (as a result of reduced plasma glucose, increased insulin sensitivity, and depletion of glycogen stores in muscle). It can occur during, immediately after, or many hours after physical activity; however, it can be avoided. Depending on the nature of the activity and its timing relative to the child's meal and insulin schedule, hypoglycemia can be prevented by:

- monitoring glucose levels before and after exercise,
- adjusting insulin dose, and/or
- supplemental snacking before, during, or after activity.

Physical activity also appears to enhance absorption from the insulin injection site, particularly from exercising arms and legs, contributing to the risk of hypoglycemia. The abdomen is, therefore, the best site for

TABLE 1

EMERGENCY ACTION PLAN FOR HYPOGLYCEMIA (LOW BLOOD SUGAR)

(Adapted from: Helping the Student with Diabetes Succeed: A Guide for School Personnel, National Diabetes Education Program, Bethesda, MD, 2003. On the web at: http://www.ndep.nih.gov/diabetes/pubsyouth/NDEPSchoolGuide.pdf)

Remember: Never send a child with suspected low blood sugar anywhere alone.

Causes of Hypoglycemia

- Too much insulin
- Missed food
- Delayed food
- Too much or too intense exercise
- Unscheduled exercise

Onset

- Sudden

Symptoms

Mild

- Hunger
- Shakiness
- Weakness
- Paleness
- Anxiety
- Irritability
- Dizziness
- Sweating
- Drowsiness
- Personality change
- Inability to concentrate
- Other: _____ _____

Circle student's usual symptoms

Moderate

- Headache
- Behavior change
- Poor coordination
- Blurry vision
- Weakness
- Slurred speech
- Confusion
- Other: _____ _____

Circle student's usual symptoms

Severe

- Loss of consciousness
- Seizure
- Inability to swallow

Circle student's usual symptoms

Actions Needed

Notify School Nurse or Trained Diabetes Personnel. If possible, check blood sugar, per Diabetes Medical Management Plan. When in doubt, always TREAT FOR HYPOGLYCEMIA.

Mild

- Student may/may not treat self.
- Provide quick-sugar source.
  - 3-4 glucosetablets
  - or
  - 4 oz. juice
  - or
  - 6 oz. regular soda
  - or
  - 3 teaspoons of glucose gel
- Wait 10 to 15 minutes.
- Recheck blood glucose.
- Repeat food if symptoms persist or blood glucose is less than ___.
- Follow with snack of carbohydrate and protein (e.g., cheese and crackers).

Moderate

- Someone assists.
- Give student quick sugar source per mild guidelines
- Wait 10 to 15 minutes
- Recheck blood glucose.
- Repeat if symptoms persist or blood glucose is less than _____.
- Follow with a snack of carbohydrate and protein (e.g., cheese and crackers).

Severe

- Don't attempt to give anything by mouth.
- Position on side, if possible.
- Contact school nurse or trained diabetes personnel.
- Administer glucagon, as prescribed.
- Call 911.
- Contact parents/guardian.
- Stay with student.

insulin administration, since absorption is more predictable from this site than from the extremities.

Delayed hypoglycemia can occur at night, 6 to 15 hours after exercise, and even may develop as long as 24 hours after prolonged exercise. It is caused by the drain on blood glucose due to the replenishment of depleted glycogen stores in muscle and the liver. Increased food intake, reduced insulin dose, and careful blood glucose monitoring in the period after exercise can prevent delayed hypoglycemia.

An emergency action plan for managing hypoglycemia should be provided by the student's healthcare team and distributed to all school personnel who interact with the student with type 1 diabetes. The plan should include the child's typical signs and symptoms for hypoglycemia, and what treatments work best. Table 1 presents a template for a hypoglycemia action plan, which can be found in the National Diabetes Education Program's publication, *"Helping the Student with Diabetes Succeed: A Guide for School Personnel."*

Physical education instructors and sports coaches must be able to recognize and assist with the treatment of hypoglycemia. School nurses can use the checklist in Table 2 to explain to coaches and physical education instructors their roles and responsibilities in helping the student with diabetes and how to

TABLE 2
HELPING THE STUDENT WITH DIABETES SUCCEED: ACTIONS FOR THE COACH AND PHYSICAL EDUCATION INSTRUCTOR*

- Encourage exercise and participation in physical activities and sports for students with diabetes as well as for other students.
- Treat the student with diabetes the same as other students, except to meet medical needs (respect the student's right to privacy and confidentiality).
- Encourage the student to have personal supplies readily accessible. Make sure blood glucose monitoring equipment is available at all activity sites.
- Allow the student to check blood glucose levels as outlined in the 504 Plan, IEP, or other education plan.
- Understand and be aware that hypoglycemia can occur during and after physical activity.
- Recognize that a change in the student's behavior could be a symptom of blood glucose changes.
- Be prepared to recognize and respond to the signs and symptoms of hypoglycemia and hyperglycemia and take initial actions in accordance with the student's Hypoglycemia or Hyperglycemia Action Plans, which specify when and how to contact the school nurse or trained diabetes personnel.
- To treat hypoglycemia, provide the student with immediate access to a fast-acting form of glucose, as outlined in the Action Plan.
- Consider taping a fast-acting form of glucose (e.g., 3 or 4 glucose tablets or hard candies) to a clipboard or include it in the First Aid pack that goes out to physical education activities, practices, and games.
- Learn about diabetes by reviewing materials contained in the guide "Helping the Student with Diabetes Succeed: A Guide for School Personnel."
- Provide input to the student's school health team as needed.
- Communicate with the school nurse and/or trained diabetes personnel regarding any observations or concerns about the student.
- Provide information for the substitute PE instructor that communicates the daily needs of the student and the Hypoglycemia or Hyperglycemia Action Plans.

*Adapted from: *Helping the Student with Diabetes Succeed: A Guide for School Personnel*, National Diabetes Education Program, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, 2003. On the web at:http://ndep.nih.gov/diabetes/pubs/Youth_NDEPSchoolGuide.pdf

implement the hypoglycemia action plan. Knowing the plan ahead of time can help reduce anxiety for school staff and possible fear and embarrassment for the student. Rehearsing the treatment recommendations in the plan with the student, teachers, and coaches at the beginning of the school year can help ensure prompt and effective treatment of a hypoglycemic episode.

A teen with diabetes who participates in a team sport may have difficulty getting the coach's permission to travel, or encounter rejection from the team. The emotional burden resulting from the fear of hypoglycemia and "feeling different" from peers must be addressed by both the student and the teacher/coach. As most older students with diabetes now tailor insulin doses and carbohydrate intake to exercise, the potential for hypoglycemia is lower.

Hyperglycemia

In children with type 1 diabetes, exercise occasionally may result in a worsening of their glucose control. Despite the fact that exercise stimulates glucose uptake, a certain amount of insulin is required. If the blood glucose is >350mg/dL, check for urine ketones. If ketones are moderate or high, exercise should be delayed until ketones are fairly low or absent. High blood glucose and the presence of high ketone levels are indications of insufficient insulin.

In the event of high blood glucose and low to no ketones, the pre-exercise snack could be reduced.

Students with type 2 diabetes have sufficient endogenous insulin available and very rarely develop hyperglycemia with ketosis. These children's metabolic control should respond well to exercise.

Suggestions for Better Management at School

Increased awareness of the benefits and challenges of physical activity for students with diabetes will aid in both short- and long-term management of diabetes at school. Working together, the student and his or her healthcare provider, parents, the school nurse, the physical education instructor, and the coach can establish plans to help the child balance the demands of exercise and glucose control.

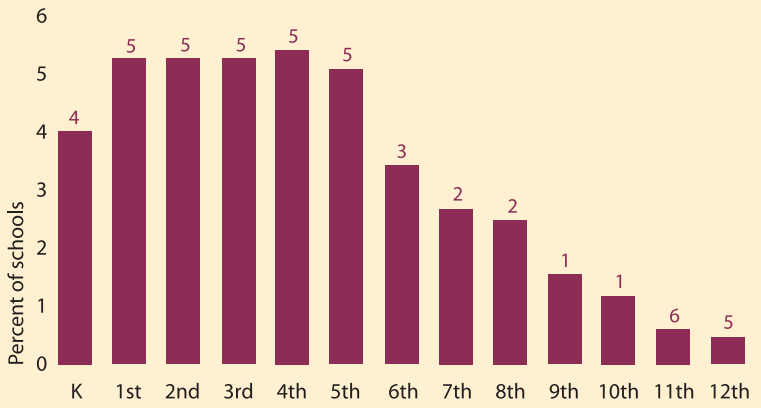
A Diabetes Medical Management Plan (DMPP), nursing care plan, 504 Plan, IEP, or other education plan should be in place for each child and include specific instructions for physical activity. The following is a general management plan for children with type 1 diabetes that should be shared with teachers, coaches and teammates.

1. *What to do before physical education class/activity*
   - Check the student's blood glucose level (preferably immediately before, but no longer than 2 hours before exercise).
   - The student should eat a carbohydrate snack per activity and blood glucose level (see Table 3).
   - If necessary, adjust the insulin dose per blood glucose and activity level in children who are on multiple daily insulin injections and on insulin pumps. This varies with the individual child. An insulin pump can either be disconnected for sports activities

TABLE 3
GUIDELINES FOR FOOD ADJUSTMENT FOR EXERCISE

Types of Exercise	Blood Glucose Level	Carbohydrate Intake
Mild to moderate intensity, of short duration Examples ■ walking 1/2 a mile ■ stretching for 30 minutes	Less than 100 mg/dL	10–15 g
	100 mg/dL and above	None required
Moderate intensity Examples ■ swimming ■ jogging ■ tennis ■ dancing	Less than 100 mg/dL	25–50 g before exercise + 10–15 g/hour of exercise
	100–180 mg/dL	10–15 g
	180–350 mg/dL	None required
	350 mg/dL and above	None required; check ketones Do not exercise if ketones are moderate to large
Strenuous Activity Examples ■ football ■ hockey ■ basketball ■ soccer	Less than 100 mg/dL	50 g
	100–180 mg/dL	25–50 g
	180–350 mg/dL	10–15 g/hour of exercise
	350 mg/dL and above	Check ketones. Do not exercise if ketones are moderate to large

GRAPH 1
PERCENT OF SCHOOLS THAT REQUIRE PHYSICAL EDUCATION, BY GRADE



CDC, School Health Policies and Programs Study 2000
Source: "Action for healthy kids" website.

and stored in a safe place or be worn with the basal rate reduced.
- The student should drink extra water. Adequate hydration is important for anyone before and during sustained exercise, but particularly for people with diabetes, given the effect of dehydration on blood glucose.
- A source of quick-acting glucose and glucose monitoring equipment should be within reach.

2. *What to do for hypoglycemia during physical activity*
- Stop the activity and let the teacher or coach know if the student has symptoms of hypoglycemia.
- Check the blood glucose as soon as symptoms are observed.
- Treat as needed according to blood glucose level and as specified in the student's action plan for hypoglycemia.
- Return to exercise if the blood glucose is at target after rechecking in 15 minutes.

3. *What to do after physical activity*
- If the child had an episode of hypoglycemia during physical activity, recheck the blood glucose.
- Provide supplemental carbohydrates in the next meal/snack.
- Be prepared to treat post-exercise hypoglycemia that may occur up to 24 hours after intense exercise.

Individual variations in insulin and carbohydrate requirements need to be taken into consideration. Adjustment of one or the other may be sufficient to prevent hypoglycemia. The most important factor is the duration and intensity of physical activity. With longer and more intense activity, a child needs less insulin and/or more supplemental carbohydrate (see Table 3).

Physical Activity in Schools and Its Impact on Student Health

Physical activity and physical education programs in schools have been drastically cut due to many constraints and pressures. The decline in the number of hours spent on exercise at schools is a significant problem, as indicated on the accompanying graph. Promoting physical activity is essential to help reduce the prevalence of obesity and type 2 diabetes in children. School nurses can play an important role as advocates for physical education in schools.

Summary

Physical activity and exercise are critical components of diabetes management. Everyone can benefit from regular exercise, but it is even more important for a student with diabetes. In addition to maintaining cardiovascular fitness and controlling weight, physical activity can help to lower blood glucose levels and increase insulin sensitivity. With the nearly epidemic incidence of childhood obesity and type 2 diabetes in youth, physical education should be part of the school day for all children.

Students with diabetes should participate fully in physical education classes and team sports. To maintain blood glucose levels within their target ranges during exercise, students with type 1 diabetes will make adjustments in their insulin and food intake. To prevent hypoglycemia, they also will need to check their blood glucose levels more frequently while engaging in physical activity.

Physical education instructors and sports coaches must be able to recognize and assist with the treatment of hypoglycemia. A quick-acting source of glucose and the student's glucose meter should always be available, along with water. The student's Diabetes Medical Management Plan, nursing care plan, 504 Plan, IEP, or other education plan should include specific instructions.

RESOURCES

Helping the Student with Diabetes Succeed: A Guide for School Personnel, National Diabetes Education Program, National Institute of Diabetes and Digestive and Kidney Diseases, Bethesda, MD, 2003. http://www.ndep.nih.gov/diabetes/pubs/Youth_NDEPSchoolGuide.pdf

The Handbook of Exercise and Diabetes, American Diabetes Association, 2002. www.diabetes.org

Be Active: Tips for Kids with Type 2 Diabetes. Tip sheet containing ideas for children and family members to increase their physical activity. http://www.ndep.nih.gov/diabetes/pubs/YouthTipsActive.pdf

Action for Healthy Kids. A nationwide initiative to improve the health and educational performance of children through better nutrition and physical activity in schools. www.actionforhealthykids.org

VERB Campaign. A national multi-media, multi-cultural campaign designed to encourage, motivate and inspire children and teenagers to become physically active. www.VERBnow.com

BAM! (Body and Mind). An interactive website designed to answer children's questions on health issues and encourage them to make their bodies and minds healthier, stronger and safer.
www.BAM.gov

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