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MINTO PREVENTION & REHABILITATION CENTRE
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Exercising With Diabetes

About This Kit

Regular exercise is extremely beneficial to the health of most people with diabetes. It can help reduce the risk for some of the chronic complications of diabetes, especially coronary heart disease. Many people with type 2 diabetes have been able to lower their blood glucose level into the normal range and control the disease by following a sensible meal plan, exercising regularly, and managing their weight.

If you have diabetes, this kit can help you learn more about how to exercise safely. If you are a caregiver for someone with diabetes, the information in this kit may help you help a friend or family member.

Please keep in mind that this kit and the Heart Institute Prevention and Rehabilitation Centre (HIPRC) Lifestyle Management and Cardiovascular Risk Reduction Programs are not a substitute for participation in a diabetes management program or your physician's advice. In particular, if you are taking insulin, we recommend you obtain assistance from your diabetes management team when implementing our exercise recommendations. In this kit you will:

Step 1. Exercise safely with diabetes
Step 2. Prevent blood glucose emergencies when exercising

This kit is one of several HIPRC educational kits on Preventing and Reversing Coronary Heart Disease. Ask about other kits in this series, including:

- Understanding Coronary Heart Disease
- Understanding Risk Factors for Coronary Heart Disease
- Understanding Cholesterol and Triglycerides
- Preventing and Managing High Cholesterol and Triglycerides
- Understanding Blood Pressure
- Preventing and Managing High Blood Pressure
- Understanding Stroke
- Understanding Risk Factors for Stroke
- Understanding Diabetes
- Managing Diabetes

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Step 1

Exercise Safely with Diabetes

Benefits of Regular Exercise

People with type 1 diabetes should not be led to believe that exercise will consistently improve their blood glucose control. It might not. Regular exercise is still beneficial for most people with type 1 diabetes, especially because of the role it plays in reducing your risk for heart attacks and strokes.

Research has shown that increased physical activity is effective in preventing and managing type 2 diabetes. And, the preventive benefit of regular exercise seems to be greatest for those at the highest risk for diabetes: people who are obese, persons with high blood pressure, and children of persons with diabetes.

There are numerous benefits of regular exercise for all people with diabetes. Regular exercise:

- Improves insulin sensitivity (enables cells to use insulin more effectively).
- Improves cardiovascular fitness.
- Reduces risk for developing coronary heart disease, stroke, and osteoporosis.
- Lowers blood pressure and triglycerides, and increases HDL ("good") cholesterol.
- Helps maintain lean body tissue (muscle) as you lose weight (fat). As much as 25% of the weight lost through dieting alone is lean body mass.
- Eases the strains and tension you may feel, both because of your diabetes and from everyday life stressors. Exercise may help you feel better, sleep better, have more energy, and feel more self-confident.

Potential Risks of Exercise

Exercise is not risk free for anyone, but especially not for people with diabetes who don't have their blood glucose levels well controlled. Depending upon the type of diabetes they have, the medications they are taking for their diabetes, and the presence of chronic diabetes complications, strenuous workouts can pose potential risks for some people. Potential risks associated with exercise include:

- Hypoglycemia (an excessive drop in blood glucose levels) for people taking insulin or oral hypoglycemic medications
- Hyperglycemia (an excessive rise in blood glucose levels) and, for those with type 1 diabetes, ketoacidosis (a dangerous condition that can result in coma)
- Cardiac complications
- Retinal bleeding in the eye
- Protein in the urine
- Excessive rise or fall of systolic blood pressure
- Steeper rise in body temperature

- Greater risk of foot injuries and problems

Overall, for most people with diabetes, the benefits of regular exercise far outweigh the risks. Ultimately, all people with diabetes should have the opportunity to benefit from the many valuable effects of exercise.

Your Exercise Plan

At HIPRC, we follow the guidelines of the Canadian Diabetes Association, the American College of Sports Medicine, Canadian Association of Cardiac Rehabilitation, and other expert groups to design safe and effective exercise programs for people with diabetes. In addition to the safety information provided in other HIPRC educational kits and in the Exercise Diary that is appropriate for all people, these recommendations are specifically for people with diabetes.

Obtain Medical Clearance – If you have diabetes, you will need medical clearance from your personal doctor to participate in an exercise program. You may need to see your doctor for a physical exam, which could include an exercise stress test or other diagnostic tests. The exam will focus on the symptoms and signs of disease affecting your heart, blood vessels, eyes, kidneys, and nervous system. An exercise stress test may be especially important if you plan to begin a vigorous exercise program and have any of the following:

- Known heart or vascular disease
- Symptoms of heart disease, such as chest discomfort with physical activity
- Age over 35
- Type 2 diabetes of more than 10 years' duration
- Type 1 diabetes of more than 15 years' duration
- Any additional risk factor for coronary heart disease
- Retinopathy (disease of the blood vessels in the retina of the eyes)
- Nephropathy (disease of the small blood vessels in the kidneys)
- Peripheral vascular disease (blockages in the arteries of the legs)
- Autonomic neuropathy (damage to nerves that control key internal organs)

By identifying any areas of concern, we can design an individualized exercise program for you that will help minimize your risk for complications. Some people may need to participate in a medically supervised exercise program in the beginning.

Know the Warning Signs of Heart Problems – Although heart problems can occur during exercise, there are usually warning symptoms that precede any event. Be sure you know and heed the symptoms that indicate possible heart problems. If you experience any of these symptoms or signs before, during, or just after your exercise session, discuss them with your doctor before continuing with your exercise program:

- Pain or discomfort in your chest, abdomen, back, neck, jaw, or arms
- A nausea sensation during or after exercise
- Unaccustomed shortness of breath during exercise
- Dizziness or fainting
- An irregular pulse, particularly when it's been regular in your past exercise sessions

Know the Symptoms of Hypoglycemia – Hypoglycemia is the major risk of exercise for people with diabetes who take insulin or oral hypoglycemic agents. The symptoms of hypoglycemia can vary considerably from one person to the next. A severe hypoglycemic reaction can cause permanent damage to your brain and nervous system. Also, be aware that hypoglycemia can occur four or more hours after you've stopped exercising. Know the symptoms of hypoglycemia and the six steps to take immediately in the event of a hypoglycemic attack. (See Step 2 of this kit.)

Mild Hypoglycemic Reaction	*Moderate Hypoglycemic Reaction*	*Severe Hypoglycemic Reaction*
• Trembling or shakiness • Nervousness • Rapid heart beat • Palpitations • Increased sweating • Excessive hunger	• Headache • Irritability and other abrupt mood changes • Impaired concentration and attentiveness • Mental confusion • Drowsiness	• Unresponsiveness • Unconsciousness and coma • Convulsions

Follow Your* HIPRC *Exercise Plan – Your mentor will outline an individualized exercise plan for you. It will include the following details:

- Type or types of aerobic activity
- Frequency of exercise (how often to exercise)
- Intensity of exercise (how hard to exercise)
- Time (number of minutes to exercise including warm-up and cool-down periods)

Generally, people with diabetes should strive to perform 20 to 60 minutes of aerobic exercise (such as walking, stationary cycling, and swimming) on three to five days each week. You should exercise at the intensity (target RPE and target heart rate ranges) that your mentor has outlined for you. For most adults with diabetes, moderate intensity exercise of longer duration is preferable to higher intensity exercise of shorter duration.

If you take insulin, you may find it easier to prevent hypoglycemia if you try to exercise at a consistent intensity and duration during each session so that similar conditions apply. You may need to be more regimented than other people about your exercise schedule. Spontaneous and abrupt changes are more likely to cause trouble. You should record your aerobic exercise activity in your HIPRC Exercise Diary. Your mentor will check your exercise records at each visit and make adjustments to your exercise program as you progress.

Stretching and strength building exercises are also important parts of your exercise program. The HIPRC educational kit "Stretching to Improve Flexibility" will outline a stretching program for you to follow. There are no special precautions for people with diabetes related to the stretching exercises recommended by HIPRC.

Although it is safe for people with uncomplicated diabetes to follow the strength training programs outlined in the HIPRC educational kit "Starting a Strength Training Program", people who have cardiac, vascular, eye, or neurological complications may need to make some adjustments. Performing strength training exercises with very heavy weights is not recommended for people with these conditions. It can cause an excessive rise in blood pressure and put extra stress on your cardiovascular system. Follow these precautions when performing strength training exercises:

- Substitute lighter weights for heavier weights and do more repetitions. Your HIPRC mentor will outline a strength training program that is appropriate for you. Generally, people with diabetes should do one set of 10 to 15 repetitions of eight to 10 different exercises that involve the major muscle groups on two or three days each week. When performing strength training exercises, you should use a weight or resistance that causes you to rate your effort at a 12 to 15 using the Rating of Perceived Exertion (RPE) scale.
- Don't hold a contraction for more than about six seconds without relaxing.
- Avoid holding your breath. Breathe normally and don't grunt or exhale forcefully without releasing the air from your lungs.
- Don't perform activities where you must hold weight above your head for more than a few seconds or that involve straining or jarring movements.

Warm-up and Cool-down – A proper warm-up session consists of a minimum of three minutes of low-intensity aerobic exercise at the beginning of every exercise session to prepare the muscles, heart, and lungs for the exercise that will follow. The cool-down at the end of the session also should last at least three minutes and gradually bring the heart rate down to near its pre-exercise level. The warm-up and cool-down are very important because most heart problems that arise during exercise do so either at the beginning or end of a session. Warm-up and cool-down are even more critical for people with autonomic neuropathy. (See the Glossary for Diabetes Complications in Step 1 of the kit "Understanding Diabetes.")

Take Special Care of Your Feet – People with diabetes need to take special precautionary measures for exercises involving the feet. Select comfortable and well-fitting shoes that are appropriate for the exercise you will do. If you have special problems (calluses, corns) or bony deformities (hammertoes, bunions), you may need to select extra-wide shoes or shoes with a high toe box. Your mentor will evaluate your feet to recommend shoes for you based on your foot type. More information about foot care is provided in the kit entitled "Managing Diabetes."

Take Precautions for the Weather – Exercising in hot or cold weather poses challenges for people with diabetes, especially those who have peripheral neuropathy or heart disease. Use good judgment about exercising in the cold or heat. In the cold, wear gloves and a hooded sweatshirt or woolen cap to cover your head. Choose clothing that provides adequate insulation from the cold, but avoid fabrics that cause excessive buildup of sweat. Dressing in layers for exercise in cold weather allows you to adjust your clothing as your body adjusts to the weather conditions. When exercising in warm or hot weather, wear clothing that promotes heat loss. Fabrics that "breathe" are a good choice.

Drink Adequate Fluids – People with diabetes, especially people with autonomic neuropathy, need to drink adequate fluids to prevent dehydration and overheating during exercise. Drink water before, during, and after exercising. Drink one cup (eight ounces) of cold water about 15 minutes before you start to exercise. Cold water is absorbed more quickly than lukewarm water. If you exercise for more than 30 minutes, drink another cup of water every 15 to 20 minutes during exercise. Remember, thirst is not a good way to know when you need water. Be aware of the symptoms of overheating (it can lead to heat stroke, which can be fatal).

- Headache
- Dizziness
- Confusion
- Stumbling
- Nausea
- Cramps
- Heavy sweating or no sweating at all

Wear A Diabetes Identification Bracelet or Shoe Tag – It is a good idea to keep identification clearly visible at all times while you are exercising.

Step 2

Prevent Blood Glucose Emergencies When Exercising

People with type 1 diabetes, and those with type 2 who are on insulin therapy or who are taking oral hypoglycemic medications, are at risk for blood sugar emergencies, especially if exercising when blood glucose levels are poorly controlled. *If you do not take insulin or oral hypoglycemic medication, this information does not apply to you.*

When you exercise with a severe insulin deficiency, you're at risk for *hyper*glycemia – a high blood sugar level. The lack of insulin causes a greater than normal increase in the production of certain hormones during exercise, such as adrenalin. These hormones, together with the insulin deficiency, cause the liver to release excessive quantities of glucose into the bloodstream. Due to the lack of insulin in the blood, the active muscles cannot take up this excess glucose. Increased blood glucose levels are the result. In view of this risk, don't exercise if your blood glucose level is above 300 mg/dl. If your blood glucose level is between 250 and 300 mg/dl, check your urine for ketones. Don't exercise if ketones are present. If ketones are present, you should gain better control of your blood glucose through your medications and food plan before you continue your exercise program. It is also a good idea to contact your health care team to let them know about the presence of ketones in your urine.

In contrast, people who are on insulin who exercise when there is too much of this medication in the bloodstream are at risk for *hypo*glycemia – a low blood sugar emergency. Hypoglycemia may occur because the excess insulin causes the liver to release too little glucose into the bloodstream while also enabling the active muscles to take up larger amounts of glucose from the blood for energy. This causes a net fall in blood glucose levels. Because certain oral hypoglycemic agents foster the body's production of and/or response to insulin, people with type 2 diabetes who take them may also be candidates for low blood sugar problems.

The best way to deal with hypoglycemia is to prevent it in the first place. These guidelines address some of the most important factors that increase the risk of developing hypoglycemia in people taking insulin and/or oral hypoglycemic medications.

- Self-monitor your blood glucose before, during, and after exercise, particularly if the workout is strenuous and lasts longer than one hour. See the guidelines at the end of this section for tailoring your diet and insulin regimen to your exercise intensity and duration.

- Reduce insulin or oral hypoglycemic medications before exercise, especially if the workout will be strenuous or longer than one hour, or if you will be exercising when the injected insulin will be exerting its peak effect (see chart below).

- Try not to exercise within the first 60 minutes after an insulin injection, especially if the exercise involves the part of the body where the insulin was injected.

- Try to exercise one to three hours after eating a regularly scheduled meal or snack.

- Eat or drink adequate amounts of carbohydrate before, during, and after exercise, particularly if your blood glucose level is below 5.5 mmol/L or if the workout is strenuous and lasts longer than one hour.

- Begin an exercise program slowly and increase the intensity and duration gradually.

- Check with your doctor when starting or stopping a new medication to see if it may increase your risk for hypoglycemia.

- Be aware of the dangers of changing insulin sources. Human insulins have a more rapid onset and shorter duration of activity than pork insulins. You should only change insulin sources under the supervision of your health care team.

- Be aware of the consequences of changing insulin injection sites and make adjustments accordingly. Your abdomen has the fastest rate of absorption, followed by your arms, thighs, and buttocks.

When Injected Insulin Exerts Its Greatest Blood-Glucose-Lowering Effect

Type of Insulin / Time Injected	*Period of Greatest Blood-Glucose-Lowering Activity*
Humalog (rapid-acting insulin) – Before (within 15 minutes before) or immediately after a meal	Action usually starts 20 to 40 minutes after injection, reaches a peak 30 to 120 minutes after injection, and keeps working for four to six hours.
Regular (short-acting insulin) – Before a meal (usually injected 30 minutes before a meal; eating before or only a few minutes after the injection is discouraged)	Action usually starts 30 to 120 minutes after injection, reaches a peak two to four hours after injection, and keeps working for three to eight hours.
NPH and Lente, Novolin 30/70 (intermediate-acting insulins) – Before breakfast and before dinner or bedtime	Action usually starts two to six hours after injection, reaches a peak four to 14 hours after injection, and keeps working for 10 to 24 hours.
Ultralente (long-acting insulin) – Before breakfast or before dinner, or half of the dose at each time	Action usually starts six to 14 hours after injection, has a minimal peak effect, and keeps working for 18 to 36 hours.

Tailoring Your Diet and Insulin Regimen to Your Exercise Intensity and Duration

The advice in the chart below is geared to people with diabetes who exercise at an intensity of 3 to 5 on the Perceived Exertion Scale. Use these guidelines as a starting point only. Fine-tune your diet and insulin regimen further based on your self-monitored blood glucose results and in consultation with your health care team.

PRE-EXERCISE GLUCOSE LEVEL	ACTION
< 5.5	Depending on intensity of expected exercise, take 1/2 - 2 full juice box(es) (10-50gm carbohydrate), retest in 15 min, and go ahead with exercise if >5.5-6. If not, repeat juice. **If taking only metformin, there is no need to treat low glucose level** .
5.5 –14	Proceed with exercise, retest after activity to determine response. (remember level may be due to recent meal). If expecting more strenuous effort, and testing <10, take 1/2 juice box (10-15gm), retest after 1/2 hr and see.
14-16	Consider urine testing for ketones - if none, proceed with light activity and plenty of fluids. **If positive for ketones, HOLD exercise.**
If on insulin, and >15	**HOLD exercise** if not explainable. Consider urine ketone testing. If no ketones, proceed with light activity and plenty of fluids. **If positive for ketones, HOLD exercise**. See your MD to re-assess diabetes care.
If Type II (on pills), and >18-20	**HOLD exercise** if not explainable. If explainable, proceed with light activity and plenty of fluids. See your MD to re-assess diabetes care.

* *Note to Exercisers on Insulin Pump Therapy*

Generally, a reduction in the basal infusion rate (by approximately 50 percent) during exercise and a reduction in the before-meal insulin bolus preceding your exercise session are sufficient measures to prevent hypoglycemia during any workout that's no longer than 45 to 60 minutes. The bolus should be reduced in accordance with the above recommendations for short-acting insulin. For longer workouts, insulin pump patients should consider doing three things:

- Reduce the before-meal insulin bolus
- Turn off the pump completely during exercise
- Reduce the basal infusion rate by 25 to 50 percent for several hours after the workout ends, depending on your post-exercise blood glucose levels.

****An Example**
Assume the total daily insulin dose is 34 units – 6 regular and 18 NPH before breakfast and 2 regular and 8 NPH before dinner. With exercise for more than an hour, reduce each of the regular and/or NPH insulins acting at the time of exercise by about 3 units. The arithmetic – 34 units X 10% = 3.4, rounded off to 3 units.

- If exercising in the morning after breakfast: the pre-breakfast insulin doses are 3 regular (6 – 3) and 18 NPH.
- If exercising in the afternoon: the pre-breakfast insulin doses are 6 regular and 15 NPH (18 - 3).
- If exercising in both the morning and afternoon: the pre-breakfast insulin doses are 3 regular (6 – 3) and 15 NPH (18 – 3).

Be Prepared for a Hypoglycemic Attack

Know the six steps to take *immediately* in the event of a hypoglycemic attack.

1. Don't hesitate to take action even if you're not sure it's hypoglycemia causing your symptoms. Hypoglycemic reactions come on suddenly and worsen quickly. If you wait too long and it is hypoglycemia, you soon won't be able to think clearly enough to take care of yourself. You could become unconscious. Educate your friends and family about the symptoms of hypoglycemia and what to do if you should have a hypoglycemic attack. Provide them with a list of emergency telephone numbers. Wear identification that says you have diabetes and don't exercise alone, especially for sessions longer than an hour or so.

2. If you are exercising, stop. If possible, test your blood glucose level to confirm that your problem is hypoglycemia.

3. Eat or drink 10 to 15 grams of simple carbohydrate or whatever quantity has proved to be effective previously. Always have some form of simple carbohydrate with you while exercising. Keep foods such as these readily available to eat if your blood glucose gets low.

½ cup fruit juice
1 cup of skim milk
½ cup regular soda (not sugar-free)
6 or 7 hard candies (not sugar-free)
1 small box of raisins
3 glucose tablets (available at pharmacies)
1 tablespoon of honey
1 tablespoon of sugar
5 small sugar cubes

4. Take at least a 10- to 15-minute rest to allow the carbohydrate to take effect. Before resuming exercise, retest your blood glucose level. If it's below 5.5 mol/L or you still don't feel right and suspect you haven't recovered completely, repeat the above steps.

5. For the remainder of your exercise session, pay close attention to any signals you get from your body so that you can be sure the hypoglycemic reaction is truly over. Also, try to measure your blood glucose level at least every 20 to 30 minutes during the remainder of your workout.

6. If you don't have a meal scheduled right after exercise, at least eat a snack that contains complex carbohydrates. Choose a healthy snack from the food groups with the "smiley faces" in your Food Diary.

Exercising With Diabetes

Before Your Next Visit

In the time between your visits with your mentor, you should read and complete your educational kits. Use this sheet to record your work. Think of this as "homework." Bring this sheet with you to your next visit.

- ❑ Complete the statements in "Check Yourself" to be sure you understand the key concepts in this kit.

Check Yourself

1. Regular exercise is beneficial for most people with type 1 diabetes because it reduces the risk for _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ and strokes.
2. Increased _ _ _ _ _ _ _ _ activity is effective in preventing and managing type 2 diabetes.
3. For all people with diabetes, regular exercise improves insulin _ _ _ _ _ _ _ _ _ _ _ _.
4. _ _ _ _ _ _ _ _ _ _ _ _ is the major risk of exercise for people with diabetes who take insulin or oral hypoglycemic agents.
5. If you have diabetes, medical _ _ _ _ _ _ _ _ from your doctor is needed to participate in an exercise program.
6. People taking insulin should consider exercising at a consistent _ _ _ _ _ _ _ _ and duration during each exercise session.
7. Performing strength training exercises with very _ _ _ _ _ weights is not recommended for people with complications of diabetes.
8. Warm-up and cool-down periods are critical for people with autonomic _ _ _ _ _ _ _ _ _ _.
9. People with diabetes need to drink adequate _ _ _ _ _ _ to prevent dehydration and overheating during exercise.
10. It is a good idea to wear diabetes _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ while exercising.
11. Exercising with a severe insulin deficiency increases the risk for _ _ _ _ _ glycemia.
12. People who are on insulin who exercise when there is too much insulin in the bloodstream are at risk for _ _ _ _ glycemia.
13. Hypoglycemic reactions come on suddenly and _ _ _ _ _ _ quickly.
14. _ _ _ _ _ _ _ your friends and family about the symptoms of hypoglycemia and what to do for a hypoglycemic attack.
15. Always carry a source of _ _ _ _ _ _ carbohydrates with you while exercising.

Answers: 1) heart attacks; 2) physical; 3) sensitivity; 4)Hypoglycemia; 5) clearance; 6) intensity; 7) heavy; 8) neuropathy; 9) fluids; 10) identification; 11) hyper; 12) hypo; 13) worsen; 14) Educate; 15) simple

Write any questions for your mentor here.