Physical Activity and Diabetes

Physical activity can help:

- Lower blood pressure
- Raise HDL (good cholesterol) and lower triglycerides
- Reduce weight and help maintain weight loss
- Increase amount of muscle mass
- Lower body fat
- Lower fibrinogin levels (blood less likely to clot)
- Maintain heart health
- Help with blood glucose control (for those with type 1 diabetes, blood glucose control is not improved with activity unless the person learns to adjust food and insulin to accommodate activity)
- Reduce psychological stress

There are also safety considerations for people with diabetes who want to become physically active:

- Many benefit from undergoing exercise testing. Heart disease is the number one cause of death for people with diabetes and they experience 2 to 4x more strokes and heart attacks than people without diabetes. Lack of anginal pain, orthostatic hypotension and autonomic neuropathy are some of the concerns, which affect the heart health of people with diabetes.

Heart Concerns
Orthostatic Hypotension

What it is:	Systolic blood pressure drops more than 30 mmHg when changing position.
Exercise consideration:	Change positions slowly.

Cardiovascular
Autonomic Neuropahty

What happens:	Nerves regulating heart function are damaged which leads to high resting pulse, blood pressure regulation concerns, pulse failing to increase as anticipated with exercise, and problems adjusting to temperature changes.
Exercise consideration:	Supervised activity in a cardiac rehab program is the safest option.

- Assess eye health through a dilated eye exam. Adjust activity based on the presence and degree of retinopathy http://www.allaboutvision.com/conditions/diabetic.htm

- Perform a thorough foot assessment, including a check for loss of protective sensation. For more details of addressing foot health, see Feet Can Last a Lifetime booklet, www.ndep.nih.gov/diabetes/pubs/Feet_HCGuide.pdf

- See Table 1 for a list of foot concerns related to diabetes and activity.

Table 1
Foot Concerns, Diabetes and Activity

Low Risk Foot	1. Annual comprehensive foot exam is recommended. 2. Make sure person can perform preventive self care. 3. Provide guidance on selecting desirable foot wear. 4. Foot health does not limit activities.
High Risk Foot (one or more of the following is true)	1. 1-3 listed above. 2. Assist with referral to specialist if therapeutic footwear needed. 3. Use caution with repeated weight bearing activity (walking). 4. Avoid ***all*** weight bearing activity if ulcer is present.

- Assess for presence of peripheral vascular disease–person may need intermittent activity program.

- Kidney health status: For people with diabetes with impaired kidney function, exercise tolerance may be diminished. They may also have problems with blood pressure regulation and heart health. A lower intensity activity program may be indicated.

- Hypoglycemia (blood glucose less than 70 mg/dL): For those who use insulin secreting medications or insulin, hypoglycemia can be a concern during, immediately or several hours after physical activity. See table 2 for a list of oral medications that can potentially cause hypoglycemia.

Table 2
Oral Medications Which Can Cause Hypoglycemia

Mode of Action	Class:
Insulin Secretagogues: Stimulates insulin secretion	**First-Generation Sulfonylureas**: Diabinese (clorpropamide) Tolinase (tolazmide) Orinase (tolbutamide) **Second-Generation Sulfonylureas:** Glucotrol (glipizide) Glucotrol XL (glipizide) Micronase or Diabeta (glyburide) Amaryl (glimepiride) **Meglitinide Analogues:** **Benzoic Acid Derivative:** Prandin (repaglinide) **D-Phenylalanine Derivative:** Starlix (nateglinide)
Combination Drugs which contain an Insulin Secretagogue:	Glucovance (glyburide/metformin) Metaglip (glipizide/metformin)

Note: *Those who also use an Alpha Glucosidase Inhibitor (Precose-acarbose or Glyset-miglitol) in conjunction with insulin or one of the insulin secretagogues will need to use* ***glucose*** *to treat low blood glucose reactions.*

How to recognize:

Some may have symptoms–sweating, shaky, pale, hungry, combative, or disoriented. Others may have very subtle signs, such as slurred speech and difficulty concentrating.

How to treat-use 15/15 Rule:

1. Administer 15 grams of carbohydrate (CHO).
2. Wait 15 minutes.
3. Recheck blood glucose. If it is still below 70 mg/dL, an additional 15 grams of CHO should be consumed. Recheck blood glucose after another 15 minutes. A meal or snack should be eaten within 1 hour. Infants and small children need less CHO to treat low blood glucose reactions. Examples of 15 grams of CHO:
    - **15 grams of carbohydrate from glucose tablets**
    - **½ cup regular soda (not diet) or juice**
    - **1 cup milk (skim)**
    - **1 Fruit Roll-Up**
    - **6-7 Lifesavers™**
    - **1 small box (2 tbsp) raisins**

Other hypoglycemia concerns:

- Greatest risk of hypoglycemia is 6-14 hours after strenuous activity.
- Risk of night time hypoglycemia is greatest when activity is in the evening.
- Every person with type 1 diabetes should have glucagon available and people around them should be experienced in administering it.

While all people with type 1 diabetes need to be knowledgeable about hypoglycemia recognition, treatment and prevention, as previously mentioned some people with type 2 diabetes will also experience low blood glucose reactions. Since many people with type 2 diabetes also have weight concerns, medication or insulin adjustment, if possible, is preferable to eating additional food to avoid or treat low blood glucose levels related to physical activity.

Hyperglycemia: Participating in sports which require intense bursts of activity (such as football, basketball, or racquetball), can actually cause blood glucose levels to increase. These glucose levels will generally lower after the activity is stopped, and then hypoglycemia becomes a concern.

If blood glucose is elevated prior to activity:

- People will need to use caution and common sense if activity is planned and glucose is greater than 240 mg/dL. People with type 1 diabetes will want to make sure that they do not have urinary ketones. If moderate to large ketones are present, activity should be delayed and treatment for high glucose/ketones begun.
- For those with type 2 diabetes, ketones are generally not a concern. If high blood glucose levels are linked to food intake, physical activity will generally help lower their blood glucose.
- Regularly elevated blood glucose levels signal the need for a thorough assessment and often require medication and/or self-management changes.

Getting Started:

- Person is cleared for physical activity.
- Physical activity concerns have been identified, and appropriate modifications have been taken into consideration.
- Start slowly, especially if person is older and has not been active regularly. For some, 10 minutes of activity (ie walking) 3x per week is the starting point.
- Progress 2-3 minutes each week until the person is active at least 30 minutes most days of the week.
- Some may not be able to tolerate 30 minutes of activity at one time. They can work toward getting 10-15 minutes 2 or 3 times per day, most days of the week.

What to Include in a Physical Activity Program:

1. **Warm Up**: Start with a few minutes of slow activity. If walking, walk slowly 5 minutes before starting "exercise" walk.
2. **Aerobic Portion**: For most that means exercise at a "somewhat hard" level. They should be able to carry on a conversation during exercise.
3. **Cool Down**: Slow the activity down for a few minutes before stopping.
4. **Stretching**: It is best to stretch following aerobic activity at least 3x per week. Sample stretching activities can be found at http://www.niapublications.org/exercisebook/chapter4.htm *Pick Stretching Exercises*

   Diabetes Considerations:
   - For those with proliferative retinopathy, make certain stretching does not include movements where the head drops below the waist.
   - For those with peripheral neuropathy, muscles tend to shorten. Gentle stretching is important; the person should take care not to over stretch.

5. **Strength Training**: Weight/strength training can help maintain muscle mass, which is important in weight loss/maintenance. In older folks, strength training assists with maintenance/return of activities of daily living. It is recommended that strength building exercises be done at least 2 days per week, with at least 1 day in between. Strength training details and sample exercises can be found at http://www.niapublications.org/exercisebook/chapter4.htm
   Pick Strength Training

   Diabetes Considerations:
   - Heavy weight lifting can be dangerous for those with proliferative retinopathy. It can also cause abnormal and dangerous blood pressure increases in some people.
   - Monitoring blood pressure during weight lifting, especially when arm exercises are being done is desirable, when first starting a program.
   - Be sure to keep breathing while weight lifting. Holding one's breath while weight lifting can also elevate the blood pressure to dangerous levels.

Type 1 Diabetes:

To optimize blood glucose control, people with type 1 diabetes need to learn how to adjust food (carbohydrate) and insulin to accommodate activity.

1. Evaluate pre-activity blood glucose
   If less than 100 mg/dL:
   - Carbohydrate is needed before starting exercise.
   - Exercise may need to be delayed.

   Glucose between 100 and 250 mg/dL:
   - Generally safe to begin exercising

   Glucose over 250 mg/dL:
   - Determine if urinary ketones are present.
   - If moderate to large ketones are present, delay exercise and begin treatment for diabetic ketoacidosis immediately.
   - No ketones present and elevated glucose related to extra snack or large meal, activity will generally help lower blood glucose.
   - Use caution if activity is planned when glucose over 300 mg/dL.
   - Determine cause of high blood glucose and make appropriate management changes to improve glucose control.

2. Maintaining glucose control through carbohydrate replacement during activity
   - Less than 30 minutes of activity, carbohydrate replacement may not be needed.
   - Between 30 and 60 minutes of activity, 15 grams of carbohydrate.
   - Over 60 minutes–at least 15 grams of carbohydrate each hour. High intensity activities may require 30 to 50 grams every hour.

3. Using insulin adjustments to help maintain glucose control:
   - Decreasing rapid or short acting insulin 30 to 50% helps lower risk of hypoglycemia (ie: decrease pre-lunch rapid/short acting if afternoon activity is planned).

     OR
   - Decrease insulin which is acting when activity is planned by 10% of the total daily insulin.
   - Depending on length, time, and intensity of activity, pre-activity glucose and pre-activity meal, carbohydrate replacement may also be needed.

Insulin Pumps and Physical Activity

Options for Maintaining Blood Glucose Control When Active:

- Decrease pre-meal bolus by up to 50% if exercise will occur less than one hour following meal (some may be able to omit pre-meal bolus).
- Do not change basal or bolus insulin; eat approximately 30 grams of CHO for every 30 minutes of intense activity.
- Decrease basal rate 20 to 50%. Start before activity begins and continue lower rate for 2 times the duration of the workout (ex: if active for 30 minutes, continue lower basal rate for 1 hour following activity).
- Remove pump during workout (up to 1 hour). If leaving pump off 1-4 hours, bolus of insulin is needed prior to removal.
- Infusion set in abdominal area on activity days may be helpful.
- May need to decrease bolus at meal following activity.
- Amount of CHO/insulin adjustment for activity depends on
    - Time of day
    - Duration
    - Relationship of activity to last meal
    - Type of activity
    - Intensity
    - Fitness level

Insulin Adjustments for Activity . . . from Deltec Cozmo

Activity	Temporary Decrease in Basal Rate
Light (walking)	10%
Moderate (biking)	30%
Strenuous (jogging)	50%
Sustained (kayaking/hiking)	20-30%

Resources:

- Animas: www.animascorp.com
- DANA Diabecare: www.theinsulinpump.com
- Deltec Cozmo: www.delteccozmo.com
- Disetronic: www.disetronic-usa.com
- Medtronic Minimed: www.minimed.com
- NIPRO Diabetes Systems: www.niprodiabetes.com

Other Exercise Safety Considerations for People with Diabetes:

1. For feet–gel or air midsoles coupled with polyester/polyester blend socks can help prevent blisters. Wear properly fitted shoes and practice regular self foot care.
2. Wear diabetes identification bracelet.
3. Maintain proper hydration–drink water before, during, and after activity.
4. Use caution if being active in hot or cold environments.
5. Carry carbohydrate replacement if using insulin or insulin secreting medication.
6. Having an "exercise buddy" is desirable.
7. People who live or work with people who have type 1 diabetes should have access to and know how to use glucagon.

Special Considerations:

Physical Activity and the Older Adult:

Regular physical activity has been found to be important to the health of older adults. In fact, in one study, after 10 weeks of simple muscle building activities, people over the age of 80 were able to go from using walkers to walking with canes. Along with diabetes related concerns, other conditions need to be taken into consideration:

1. Congestive Heart Failure: Physical activity is dangerous when a person is having a flare-up.
2. Arthritis: Activity is beneficial for people with arthritis. It can reduce joint pain and stiffness in addition to all of the other benefits related to physical activity. If joints become painful, inflamed, or red, physical activity should be limited. For more details, go to http://health.nih.gov/result.asp/53
3. Conditions which may affect gait or balance such as Parkinson's Disease.
4. Visual Impairments.

Physical Activity and Overweight

- Begin activity program slowly and progress gradually.
- Avoid extreme temperatures.
- Vary non-weight bearing with low or moderate impact activity (swimming one day, walking the next day).
- Dress in loose comfortable clothing, in layers.
- Supportive athletic shoes are important.

Children:

Children and youth with type 1 diabetes present special challenges as activity levels can be unpredictable and hormonal changes adolescents go through can make blood glucose control more difficult. Adults (parents, teachers, and coaches) can play an important role in helping children "be kids" while balancing blood glucose levels.

Strategies to Increase Activity Levels:

Structured vs. Lifestyle Approaches

For some, incorporating additional activity into their daily lives works better than a structured activity program. Pedometers and 10,000 Step programs have become increasingly popular in helping people take extra steps throughout the day to gradually increase their level of activity.

A sampling of the 10,000 Steps programs are listed below:

- America on the Move: www.americaonthemove.org
- Health Partners: www.healthpartners.com
- Michigan on the Move: www.michiganfitness.org (Also view their list other fitness related events in Michigan).
- Shape Up America: www.shapeup.org
- StepUP (Upper Peninsula of Michigan program): www.fitup.org

Population Based Interventions:

A review of the physical activity literature has determined methods which have been shown to help increase physical activity levels.

Strong Evidence:

1. Informational approaches
    a. Community-wide campaigns
    b. School based physical education
    c. Non-family support
2. Behavioral and social approaches
3. Individually adopted health behavior change
4. Environmental and policy approaches
5. Creation and/or enhanced access to places for physical activity combined with informational outreach activities.

Sufficient Evidence:

1. Informational approach

"Point of Decision" prompts

Other methods may also work, but scientific evidence is not available which supports their use. To read more about the above approaches, go to http://www.thecommunityguide.org/pa/default.htm

Diabetes Prevention:

- Physical activity is also one of the key components in the prevention of diabetes.
- In the Diabetes Prevention Program (DPP), adults at high risk of developing diabetes showed a 58% lower rate of diabetes development when:
  - They were physically active for 30 minutes, 5x per week (150 minutes).
  - They lost about 7% of their body fat.
- Older adults in the DPP showed more than a 70% lower rate of diabetes development by getting active and losing a little weight.

For more details:
Diabetes Prevention Program: http://diabetes.niddk.nih.gov/dm/pubs/preventionprogram
National Diabetes Education Program www.ndep.nih.gov

Nearly half of all Americans report that they are not active at all and 70% do not get the recommended 30 minutes of activity most days of the week. Being physically active most days of the week drastically reduces the risk of developing type 2 diabetes, heart disease, and certain cancers, such as colon cancer. Regular physical activity also helps lower blood pressure and cholesterol, assists with weight control, reduces symptoms of depression and anxiety, helps maintain bond health, and decrease symptoms of arthritis. For people with diabetes, activity can also assist with blood glucose control.

With our increasing rates of diabetes and diabetes related complications, physical activity is one component of care which is very inexpensive and yields huge benefits.

References: Physical Activity and Diabetes Links

American Diabetes Association: Consumer information:http://www.diabetes.org/weightloss-and-exercise/exercise/overview.jsp, Position statement on physical activity/exercise and diabetes: http://care.diabetesjournals.org/cgi/content/full/27/suppl_1/s58

Diabetes, Exercise and Sports Association: http://www.diabetes-exercise.org/index.asp

Joslin Diabetes Center:
http://www.joslin.harvard.edu/education/library/exercise_health.shtml

Mayo Clinic:
http://www.mayoclinic.com/findinformation/conditioncenters/subcenters.cfm?objectid=5C957BF7-C592-413E-9CFF57975A3B0881

National Diabetes Education Program http://www.ndep.nih.gov

References: Physical Activity - general links

Michigan Council on Physical Fitness Health and Sports http://www.michiganfitness.org/

National Center for Chronic Disease Prevention and Health Promotion
http://www.cdc.gov/nccdphp/dnpa/

President's Council on Physical Fitness, Health and Sports http://www.fitness.gov/

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