Exercise for people with diabetes: medical considerations in various situations

국립중앙의료원 내과 조영중

함께할 내용

- ✓ 운동과 관련된 부작용을 최소화하기 위한 권고사항
- ✓ Exercise considerations for medications
- ✓ Physical activity considerations for exercising with health-related complications

Source: Physical Activity/Exercise and Diabetes: A Position Statement of the American Diabetes Association (*Diabetes Care 2016;39:2065-2079*)

Pre-exercise Health Screening and Evaluation

- Pre-exercise medical clearance is not necessary for asymptomatic individuals receiving diabetes care consistent with guidelines who wish to begin low- or moderate-intensity physical activity not exceeding the demands of brisk walking or everyday living.

- Some individuals who plan to increase their exercise intensity or who meet certain higher-risk criteria may benefit from referral to a health care provider for a checkup and possible exercise stress test before starting such activities.

Suggested carbohydrate intake or other actions based on blood glucose levels at the start of exercise

Pre-exercise blood glucose	Carbohydrate intake or other action
<90 mg/dL (<5.0 mmol/L)	• Ingest 15–30 g of fast-acting carbohydrate prior to the start of exercise, depending on the size of the individual and intended activity; some activities that are brief in duration (<30 min) or at a very high intensity (weight training, interval training, etc.) may not require any additional carbohydrate intake. • For prolonged activities at a moderate intensity, consume additional carbohydrate, as needed (0.5–1.0 g/kg body mass per h of exercise), based on blood glucose testing results.
90–150 mg/dL (5.0–8.3 mmol/L)	• Start consuming carbohydrate at the onset of most exercise (~0.5–1.0 g/kg body mass per h of exercise), depending on the type of exercise and the amount of active insulin.
150–250 mg/dL (8.3–13.9 mmol/L)	• Initiate exercise and delay consumption of carbohydrate until blood glucose levels are <150 mg/dL (<8.3 mmol/L).
250–350 mg/dL (13.9–19.4 mmol/L)	• Test for ketones. Do not perform any exercise if moderate-to-large amounts of ketones are present. • Initiate mild-to-moderate intensity exercise. Intense exercise should be delayed until glucose levels are <250 mg/dL because intense exercise may exaggerate the hyperglycemia.
≥350 mg/dL (≥19.4 mmol/L)	• Test for ketones. Do not perform any exercise if moderate-to-large amounts of ketones are present. • If ketones are negative (or trace), consider conservative insulin correction (e.g., 50% correction) before exercise, depending on active insulin status. • Initiate mild-to-moderate exercise and avoid intense exercise until glucose levels decrease.

Adapted from Zaharieva and Riddell (88).

- Target range for blood glucose prior to exercise : 90-250 mg/dL
- Carbohydrate intake required will vary with insulin regimens, timing of exercise, type of activity, and more, but it will also depend on starting blood glucose levels.

Suggested initial pre-exercise meal insulin bolus reduction for activity started within 90 min after insulin administration

	Exercise duration	
Exercise intensity	30 min	60 min
Mild aerobic (~25% VO_{2max})	−25%*	−50%
Moderate aerobic (~50% VO_{2max})	−50%	−75%
Heavy aerobic (70%−75% VO_{2max})	−75%	N-A
Intense aerobic/anaerobic (>80% VO_{2max})	No reduction recommended	N-A

Recommendations compiled based on four studies (94–97). N-A, not assessed as exercise intensity is too high to sustain for 60 min. *Estimated from study (95).

Minimizing Exercise-Related Adverse Events in People with Diabetes

Recommendations

- Insulin regimen and carbohydrate intake changes should be used to prevent exercise-related hypoglycemia. Other strategies involve including short sprints, performing resistance exercise in the same session, and activity timing. **B**

- Risk of nocturnal hypoglycemia following physical activity may be mitigated with reductions in basal insulin doses, inclusion of bedtime snacks, and/or use of continuous glucose monitoring. **C**

- Execise-induced hyperglycemia is more common in type 1 diabetes but may be modulated with insulin administration or a lower intensity aerobic cooldown. Exercising with hyperglycemia and elevated blood ketones is not recommended. **C**

Minimizing Exercise-Related Adverse Events in People with Diabetes

Recommendations

- Some medications besides insulin may increase the risks of exercise-related hypoglycemia and doses may need to be adjusted based on exercise training. **C**

- Older adults with diabetes or anyone with autonomic neuropathy, cardiovascular complications, or pulmonary disease should avoid exercising outdoors on very hot and/or humid days to prevent heat-related illnesses. **C**

- Exercise training should progress appropriate to minimize risk of injury. **C**

Exercise considerations for diabetes, hypertension, and cholesterol medications and recommended safety and dose adjustments

Diabetes Medication

- Insulin

Exercise considerations

- Deficiency: hyperglycemia, ketoacidosis
- Excess: hypoglycemia during and after exercise

Safety/dose adjustments

- increase insulin dose pre- and postexercise for deficiency
- decrease prandial and/or basal doses for excess insulin

Diabetes Medication

- Insulin secretagogues
  - Exercise-induced hypoglycemia
  - If exercise-induced hypoglycemia has occurred, decrease dose on exercise days to reduce hypoglycemia risk

- Metformin
  - None
  - Generally safe; no dose adjustment for exercise

- Thiazolidinedione
  - Fluid retention
  - Generally safe; no dose adjustment for exercise

Diabetes Medication

- DPP4 inhibitors
  - Slight risk of CHF with saxagliptin and alogliptin
  - Generally safe; no dose adjustment for exercise

- GLP1 receptor agonists
  - May increase risk of hypoglycemia when used with insulin or sulfonylureas but not when used alone
  - Generally safe; no dose adjustment for exercise but may need to lower insulin or sulfonylurea dose

- SGLT2 inhibitors
  - May increase risk of hypoglycemia when used with insulin or sulfonylureas but not when used alone
  - Generally safe; no dose adjustment for exercise

Hypertension Medication

- ß-blockers
  - Hypoglycemia unawareness and unresponsiveness; may reduce maximal exercise capacity
  - Check blood glucose before and after exercise; treat hypoglycemia with glucose

- Other agents
  - Regular exercise training may lower blood pressure; some agents increase risk of dehydration
  - Doses may need to be adjusted to accommodate the improvements from training and avoid dehydration

Cholesterol Medication

- Statin
  - Muscle weakness, discomfort, and cramping in a minority of users
  - Generally safe; no dose adjustment for exercise

- Fibric acid derivatives
  - Rare myositis or rhabdomyolysis; risk increased with gemfibrozil and statin combination
  - Avoid exercise if these muscle conditions are present

Physical activity consideration, precaution, and recommended activities for exercising with health-related complications

Cardiovascular disease

- Coronary heart disease

Exercise considerations

- Coronary perfusion may actually be enhanced during higher-intensity aerobic or resistance exercise.

Physical activity recommendations/precautions

- All activities okay.
- Consider exercising in a supervised cardiac rehabilitation program, at least initially.

Cardiovascular disease

- Exertional angina
  - Onset of chest pain on exertion, but exercise-induced ischemia may be silent in some with diabetes.
  - All activities okay, but heart rate should be kept ≥10 bpm below onset of exercise-related angina.

- Hypertension
  - Both aerobic and resistance training may lower resting BP and should be encouraged.
  - Some BP medications can cause exercise-related hypotension.
  - Ensure adequate hydration during exercise.
  - Avoid Valsalva maneuver during resistance training.

Cardiovascular disease

- Myocardial Infarction
  - Stop exercise immediately should symptoms of myocardial infarction (such as chest pain, radiating pain, shortness of breath, and others) occur during physical activity and seek medical attention.
  - Restart exercise after MI in a supervised cardiac rehabilitation program.
  - Start at a low intensity and progress as able to more moderate activities.
  - Both aerobic and resistance exercise are okay.

Cardiovascular disease

- Stroke
  - Diabetes increase the risk of ischemic stroke.
  - Stop exercise immediately if symptoms of a stroke (occurring suddenly and often affecting only one side of body) happen during exercise.
  - Restart exercise after stroke in a supervised cardiac rehabilitation program.
  - Start at a low intensity and progress as able to more moderate activities.
  - Both aerobic and resistance exercise are okay.

Cardiovascular disease

- Congestive heart failure (CHF)
  - Most common cause is coronary artery disease and frequently follows a myocardial infarction.
  - Avoid activities that cause an excessive rise in heart rate.
  - Focus more on doing low- or moderate-intensity activities.

Cardiovascular disease

- Peripheral artery disease
  - Lower-extremity resistance training improves functional performance.
  - Low- or moderate-intensity walking, arm ergometer, and leg ergometer preferred as aerobic activities.
  - All other activities okay.

Nerve disease

- Peripheral neuropathy

  - Regular aerobic exercise may also prevent the onset or delay the progression of peripheral neuropathy in both type 1 and type 2 diabetes.
  - Proper care of the feet is needed to prevent foot ulcers and lower the risk of amputation.
  - Keep foot dry and use appropriate footwear, silicagel or air midsoles, and polyester or blend socks (not pure cotton).
  - Consider inclusion of more non-weight-bearing activities, particularly if gait altered.

Nerve disease

- Local foot deformity
  - Manage with appropriate footwear and choice of activities to reduce plantar pressure and ulcer risk.
  - Focus more on non-weight bearing activities to reduce undue plantar pressure.
  - Examine feet daily to detect and treat blisters, sores, or ulcers early.

- Foot ulcers/amputation
  - Moderate walking is not likely to increase risk of foot ulcers or reulceration with peripheral neuropathy.

Nerve disease

- Foot ulcers/amputation

  - Weight-bearing activity should be avoided with unhealed ulcers.
  - Examine feet daily to detect and treat blisters, sores, or ulcers early.
  - Amputation sites should be properly cared for daily.
  - Avoid jogging.

Nerve disease

- Autonomic neuropathy
  - May cause postural hypotension, chronotropic incompetence, delayed gastric emptying, altered thermoregulation, and dehydration during exercise.
  - Exercise-induced hypoglycemia may be harder to treat in those with gastroparesis.
  - With postural hypotension, avoid activities with rapid postural or directional changes to avoid fainting or falling.
  - With cardiac autonomic neuropathy, obtain physician approval and possibly undergo symptom-limited exercise testing before commencing exercise.

Nerve disease

- Autonomic neuropathy

  - With blunted heart rate response, use heart rate reserve and ratings of perceived exertion to monitor exercise intensity.
  - With autonomic neuropathy, avoid exercise in hot environments and hydrate well.

Eye disease

- Mild to moderate nonproliferative retinopathy
  - Individuals with mild to moderate nonproliferative changes have limited or no risk for eye damage from physical activity.
  - All activities okay with mild, but annual eye exam should be performed to monitor progression.
  - With moderate nonproliferative retinopathy, avoid activities that dramatically elevate blood pressure, such as powerlifting.

Eye disease

- Severe nonproliferative and unstable proliferative retinopathy
  - Individuals with unstable diabetic retinopathy are at risk for vitreous hemorrhage and retinal detachment.
  - Avoid activities that dramatically elevate BP, such as vigorous activity of any type.
  - Avoid vigorous exercise; jumping, jarring, and head-down activities; and breath holding.
  - No exercise should be undertaken during a vitreous hemorrhage.

Eye disease

- Cataracts
  - Cataracts do not impact the ability to exercise, only the safety of doing so due to loss of visual acuity.
  - Avoid activities that are more dangerous due to limited vision, such as outdoor cycling.
  - Consider supervision for certain activities.

Kidney disease

- Microalbuminuria

  - Exercise does not accelerate progression of kidney disease even though protein excretion acutely increases afterward.
  - Greater participation in moderate-to-vigorous leisure time activity and higher physical activity levels may actually moderate the initiation and progression of diabetic nephropathy.
  - All activities okay, but vigorous exercise should be avoided the day before urine protein tests are performed to prevent false positive readings.

Kidney disease

- Overt nephropathy
  - Both aerobic and resistance training improve physical function and quality of life in individuals with kidney disease.
  - Individuals should be encouraged to be active.
  - All activities okay, but exercise should begin at a low intensity and volume if aerobic capacity and muscle function are substantially reduced.

Kidney disease

- End-stage renal disease
  - Doing supervised, moderate aerobic physical activity undertaken during dialysis sessions may be beneficial and increase compliance.
  - Exercise should begin at a low intensity and volume if aerobic capacity and muscle function are substantially reduced.
  - Electrolytes should be monitored when activity done during dialysis sessions.

Orthopedic limitations

- Structural changes to joints

  - Individuals with diabetes are more prone to structural changes to joints that can limit movement, including shoulder adhesive capsulitis, carpal tunnel syndrome, metatarsal fractures, and neuropathy-related joint disorders (Charcot foot).
  - In addition to engaging in other activities (as able), do regular flexibility training to maintain greater joint range of motion.
  - Stretch within warm-ups or after an activity to increase joint range of motion best.
  - Strengthen muscles around affected joints with resistance training.
  - Avoid activities that increase plantar pressure with Charcot foot changes.

Orthopedic limitations

- Arthritis
  - Common in lower-extremity joints, particularly in older adults who are overweight or obese.
  - Participation in regular physical activity is possible and should be encouraged.
  - Moderate activity may improve joint symptoms and alleviate pain.
  - Most low- and moderate-intensity activities okay, but more non-weight-bearing or low-impact exercise may be undertaken to reduce stress on joints.
  - Do range-of-motion activities and light resistance exercise to increase strength of muscles surrounding affected joints.
  - Avoid activities with high risk of joint trauma, such as contact sports and ones with rapid directional changes.

Managing Physical Activity with Health Complications

Recommendations

- Physical activity with vascular disease can be undertaken safely but with appropriate precautions. **B**
- Physical activity done with peripheral neuropathy necessitates proper foot care to prevent, detect, and prevent problems early to avoid ulceration and amputation. **B**
- The presence of autonomic neuropathy may complicate being active; certain precautions are warranted to prevent problems during activity. **C**

Managing Physical Activity with Health Complications

Recommendations

- Vigorous aerobic or resistance exercise; jumping, jarring, head-down activities; and breath holding should be avoided in anyone with severe nonproliferative and unstable proliferative diabetic retinopathy. **E**
- Exercise does not accelerate progression of kidney disease and can be undertaken safely, even during dialysis sessions. **C**
- Regular stretching and appropriate progression of activities should be done to manage joint changes and diabetes-related orthopedic limitations. **C**

경청해 주셔서 감사합니다!