

- Nephropathy*
 - SBP should not rise above 180 mm/Hg.
 - Avoid weight lifting, breath holding, or high-intensity aerobic exercise.
- Retinopathy^{10,*}
 - Avoid head jarring activities.
 - Avoid valsalva.
 - Avoid position with the head below the waist.
 - SBP should not rise above 20–30 mm/Hg above RBP.
- Autonomic Neuropathy*
 - Monitor blood glucose signs more closely.
 - Monitor for signs and symptoms of silent ischemia (eg, dyspnea, diaphoresis, orthostatic hypotension).
 - Be aware BP and HR response to exercise may be blunted.
- Be aware of A1C values – generally below 7% is considered good control.⁵
- Fast acting carbohydrate must be carried at all times.*
- Carbohydrate should be ingested if glucose levels are < 70 mg/dL.*
- Vigorous exercise above 80% of Karvonen can cause hyperglycemia after exercise.*
- Fluid ingestion should occur before, during, and after exercise.*
- Proper foot wear/vigilant foot inspection should be performed.*
- Exercise should be avoided prior to going to bed.*
- Rotate insulin injection sites away from active muscles.⁹
- ID must be carried at all times.*

Medications That Can Be Major Risk for Immediate and Delayed Hypoglycemic Event*

- Insulin
- Sulfonylureas such as Amaryl® (glimepiride), DiaBeta® (glyburide), Diabinese® (chlorpropamide), Glucotrol® and Glucotrol XL® (glipizide), Glynase PresTab® (glyburide), Micronase® (glyburide), Orinase® (tolbutamide), Tolinase® (tolazamide)

*expert consensus

This document is not intended for use as a patient/client handout.



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Physical Fitness and Type 2 Diabetes Based on Best Available Evidence

Description of Diabetes Mellitus

Type 2 diabetes accounts for ~90–95% of individuals with diabetes. As obesity and inactivity are the major modifiable risk factors for type 2 diabetes,¹ that is the focus of this document. Additional information on diabetes in all forms and related resources can be found at www.apta.org/pfsp.

Screening for Metabolic Syndrome and Type 2 Diabetes

Screening for Metabolic Syndrome

Metabolic syndrome (MetS) is a constellation of characteristics that place an individual at risk for CVD and type 2 diabetes. The following **national**² characteristics (3 of 5) or **international**³ (elevated waist circumference and 2 of the remaining 4) can be used in screening for MetS:

- 1) Elevated waist circumference
 - National**
 - 40 in / 102 cm for all males
 - ≥ 35 in / 88 cm for females^{4,3}
 - International**
 - ≥ 94 cm (37.0 in) in Non-Hispanic white males
 - ≥ 90 cm (35.4 in) in Mexican American males
 - ≥ 80 cm (31.5 in) in all females
- 2) Triglycerides ≥ 150 mg/dL
- 3) HDL < 40 mg/dL for males or < 50 mg/dL for women
- 4) HTN with SBP ≥ 130 and/or DBP ≥ 85 mm Hg and/or pharmacological treatment
- 5) Elevated fasting blood glucose ≥ 100 mg/dL and/or pharmacological treatment

If screening indicates elevated waist circumference and hypertension as noted above, contact the patient's medical provider regarding a blood test to confirm or rule out MetS and coordinate management.

Selected Readings

- American Diabetes Association. Position Statement. Standards of Medical Care in Diabetes—2007. *Diabetes Care*. 2007;30:S4–S41.
- Sigal RJ, Kenny GP, Wasserman DH, Castaneda-Sceppa C. Physical Activity/Exercise and Type 2 Diabetes, Technical Review, American Diabetes Association. *Diabetes Care*. 2004;27(10):2518-2539.
- Whaley MH, Brubaker PH, and Otto RM. Eds. *ACSM'S Guidelines for Exercise Testing and Prescription*, 7th edition. Philadelphia, Pa: Lippincott Williams & Wilkins; 2006.

A complete list of citations and additional information are available at www.apta.org/pfsp.

Screening/Risk Factors for Type 2 Diabetes^{4,5}

Important for all individuals > 45 yrs of age and at 3-year intervals thereafter.

History/Interview:	
Family history of diabetes	Hypertension
Obesity	Dyslipidemia
High risk ethnic or racial group (African American, Latino, Native American, Asian American, Pacific Islander)	Gestational diabetes
	Sedentary lifestyle
	Delivery of a baby > 9lb/4kg
History of impaired glucose tolerance	Polycystic ovarian syndrome
	History of vascular disease

Symptoms of Type 2 Diabetes⁶

Polyuria, polydipsia, and glucosuria.

Exercise for Individuals With Type 2 Diabetes

Criteria for an Exercise Test with ECG^{7,8,*}

Any of the following:

- Initiating exercise (> 60% max HR or > brisk walking)
- 35 yrs and older
- Type 2 DM > 10 yrs
- CAD risk factors such as: BP > 140/90, smoking, dyslipidemia or family H/O premature CAD
- Any complication of diabetes (eg nephropathy, retinopathy, neuropathy)
- Peripheral vascular disease
- Autonomic neuropathy (potentially indicated by resting HR > 100 bpm, orthostasis, no increase in heart rate during physical activity, undesirable exercise-induced elevation of blood pressure)

Activity/Exercise Prescription

A specific exercise prescription leading to optimal outcomes is best determined using a sign or symptom limited maximal exercise test. The following general criteria may be used:^{9,10,*}

Aerobic Training

- Intensity: Determined by Karvonen's formula (HR reserve): $[(HR_{peak} - HR_{rest}) \times (40 - 70\%)] + HR_{rest}$
- Duration: 20–30 minutes, with additional 5–10 minute warm-up and cool-down
- Frequency: 4–7 days per week, or every other day

Resistance Training

- 8–10 repetition max weight, begin with 1 set, progress to 3 sets
- Include 8–10 major muscle groups
- 2–3 days per week

For individuals who meet criteria for ECG-monitored exercise testing, but for whom it is not available, exercise may safely be initiated at an intensity comparable to a brisk walk, provided there are no signs or symptoms of intolerance, and the HR is within 20 beats above the standing RHR. Subjective rating scales for effort or dyspnea may be used to define individual tolerance for the activity.

Absolute Contraindications to Exercise

- Ingesting alcohol 3 hours prior to exercise*
- Hypoglycemia < 70 mg/dL. Symptoms include:¹¹
 - Shakiness
 - Pale skin color
 - Dizziness
 - Behavior changes
 - Sweating
 - Clumsy/jerky movements
 - Hunger
 - Seizure
 - Headache
 - Tingling sensations around the mouth
- Hyperglycemia > 300 mg/dL with ketones.¹⁰ Ketones with one or more of these symptoms require emergency treatment.¹²
 - Shortness of breath
 - Nausea and vomiting
 - Breath that smells fruity
 - A very dry mouth

Relative Contraindications Requiring Closer Monitoring - Based on Blood Glucose^{9,10,*}

Blood Glucose	What to do	Comments
70–100 mg/dL	Snack	15g carb every hour of moderately intense activity
100–300 mg/dL	Proceed with exercise program	
> 300 mg/dL and on oral meds	Try 10–15 minutes of activity	If BG rises: stop If BG drops: continue, rechecking every 10–15 minutes
> 300 mg/dL and on insulin	Should be checked for ketones* (via urine dip stick or Precision Xtra [®] glucose meter)	If (+) ketones: avoid activity If (-) ketones: participate with close BG monitoring

Relative Contraindications Requiring Close Monitoring - For Those Without a Graded Exercise Test With ECG:^{10,*}

- Age > 40 yrs, w/ or w/o CVD risk factors other than diabetes
- Age > 30 yrs and any one or more of the following:
 - Type 2 diabetes of > 10 yrs duration
 - Cigarette smoking
 - Dyslipidemia
 - Proliferative or preproliferative retinopathy
 - Nephropathy, including microalbuminuria
- Any of the following, regardless of age:
 - Known or suspected CAD, CVD, and/or PVD
 - Autonomic neuropathy
 - Advanced nephropathy with renal failure

References for Pocket Guide: Physical Fitness and Type 2 Diabetes

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- ¹⁰ Sigal RJ, Kenny GP, Wasserman DH, Castaneda-Sceppa C.; Physical Activity/Exercise and Type 2 Diabetes, Technical Review, American Diabetes Association. *Diabetes Care*. 2004;27(10):2518-2539.
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- ¹⁴ American Diabetes Association: Clinical Practice Recommendations 2004: Position Statement. Physical Activity/Exercise and Diabetes. *Diabetes Care*. 2004;27(1):S1, Jan 2004. http://care.diabetesjournals.org/cgi/content/full/27/suppl_1/s58. Accessed on September 13, 2007.