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Exercise and Type 2 Diabetes: The American College of Sports Medicine and the American Diabetes Association: joint position statement executive summary

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Exercise and Type 2 Diabetes

The American College of Sports Medicine and the American Diabetes Association: joint position statement executive summary

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Although physical activity (PA) is a key element in the prevention and management of type 2 diabetes, many with this chronic disease do not become or remain regularly active. High-quality studies establishing the importance of exercise and fitness in diabetes were lacking until recently, but it is now well established that participation in regular PA improves blood glucose control and can prevent or delay type 2 diabetes, along with positively impacting lipids, blood pressure, cardiovascular events, mortality, and quality of life. Structured interventions combining PA and modest weight loss have been shown to lower risk of type 2 diabetes by up to 58% in high-risk populations. Most benefits of PA on diabetes management are realized through acute and chronic improvements in insulin action, accomplished with both aerobic and resistance training. The benefits of physical training are discussed, along with recommendations for varying activities, PA-associated blood glucose management, diabetes prevention, gestational diabetes mellitus, and safe and effective practices for PA with diabetes-related complications.

Diabetes has become a widespread epidemic, primarily due to increasing prevalence and incidence of type 2 diabetes. According to the Centers for Disease Control and Prevention, in 2007 almost 24 million Americans had diabetes, with one-quarter of those, or six million, undiagnosed (1). Currently, it is estimated that almost 60 million U.S. residents also have prediabetes—a condition in which blood glucose levels are above normal—thus greatly increasing their risk of type 2 diabetes (1). Lifetime risk estimates suggest that one in three Americans born in 2000 or later will develop diabetes, but in high-risk ethnic populations, closer to 50% may develop it (2). Diabetes is a significant cause of premature mortality and morbidity related to cardiovascular disease, blindness, kidney and nerve disease, and amputation (1). Although regular PA may prevent or delay diabetes and its complications (3–10), the majority of people with type 2 diabetes are not active (11).

In this article, the broader term "physical activity" (defined as bodily movement produced by the contraction of skeletal muscle that substantially increases energy expenditure) is used interchangeably with "exercise," which is defined as a subset of PA done with the intention of developing physical fitness (i.e., cardiovascular, strength, and flexibility training). The intent is to recognize that many types of physical movement may have a positive impact on physical fitness, morbidity, and mortality in individuals with type 2 diabetes.

Conclusion

Exercise plays a major role in the prevention and control of insulin resistance, prediabetes, gestational diabetes mellitus, type 2 diabetes, and diabetes-related health complications. Both aerobic training and resistance training improve insulin action, at least acutely, and can assist with management of blood glucose levels, lipids, blood pressure, cardiovascular risk, mortality, and quality of life, but exercise must be undertaken regularly to have continued benefits and likely include regular training of varying types. Most people with type 2 diabetes can perform exercise safely, as long as certain precautions are taken. The inclusion of an exercise program or other means of increasing overall PA is critical for optimal health in individuals with type 2 diabetes.

Both the American College of Sports Medicine (ACSM) and the American Diabetes Association (ADA) reviewed the relevant, published research and developed the recommendations that are defined in Table 1 and listed in Table 2. The entire position statement can be accessed online at http://care.diabetesjournals.org.

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See accompanying article, p. e147.

Table 1—*Evidence categories for ACSM and evidence-grading system for clinical practice recommendations for ADA*

I. ACSM evidence categories

Evidence category	Source of evidence	Definition
A	Randomized, controlled trials (overwhelming data)	Provides a consistent pattern of findings with substantial studies
B	Randomized, controlled trials (limited data)	Few randomized trials exist, which are small in size, and results are inconsistent
C	Nonrandomized trials, observational studies	Outcomes are from uncontrolled, nonrandomized, and/or observational studies
D	Panel consensus judgment	Panel's expert opinion when the evidence is insufficient to place it in categories A through C

II. ADA evidence-grading system for clinical practice recommendations

Level of evidence	Description
A	Clear evidence from well-conducted, generalizable, randomized, controlled trials that are adequately powered, including the following:
	• Evidence from a well-conducted multicenter trial
	• Evidence from a meta-analysis that incorporated quality ratings in the analysis
	Compelling nonexperimental evidence, i.e., the "all-or-none" rule developed by the Centre for Evidence-Based Medicine at Oxford
	Supportive evidence from well-conducted, randomized, controlled trials that are adequately powered, including the following:
	• Evidence from a well-conducted trial at one or more institutions
	• Evidence from a meta-analysis that incorporated quality ratings in the analysis
B	Supportive evidence from well-conducted cohort studies, including the following:
	• Evidence from a well-conducted prospective cohort study or registry
	• Evidence from a well-conducted meta-analysis of cohort studies
	Supportive evidence from a well-conducted case-control study
C	Supportive evidence from poorly controlled or uncontrolled studies, including the following:
	• Evidence from randomized clinical trials with one or more major or three or more minor methodological flaws that could invalidate the results
	• Evidence from observational studies with high potential for bias (such as case series with comparison to historical controls)
	• Evidence from case series or case reports
	Conflicting evidence with the weight of evidence supporting the recommendation
E	Expert consensus or clinical experience

Table 2—*Summary of ACSM evidence and ADA clinical practice recommendation statements*

	ACSM evidence and ADA clinical practice recommendation statements	ACSM evidence category (A, highest; D, lowest)/ ADA level of evidence (A, highest; E, lowest)
Acute effects of exercise	• PA causes increased glucose uptake into active muscles balanced by hepatic glucose production, with a greater reliance on carbohydrate to fuel muscular activity as intensity increases.	A/*
	• Insulin-stimulated blood glucose uptake into skeletal muscle predominates at rest and is impaired in type 2 diabetes, while muscular contractions stimulate blood glucose transport via a separate, additive mechanism not impaired by insulin resistance or type 2 diabetes.	A/*
	• Although moderate aerobic exercise improves blood glucose and insulin action acutely, the risk of exercise-induced hypoglycemia is minimal without use of exogenous insulin or insulin secretagogues. Transient hyperglycemia can follow intense PA.	C/*
	• The acute effects of resistance exercise in type 2 diabetes have not been reported, but result in lower fasting blood glucose levels for at least 24 h postexercise in individuals with impaired fasting glucose.	C/*
	• A combination of aerobic and resistance exercise training may be more effective in improving blood glucose control than either alone; however, more studies are needed to determine whether total caloric expenditure, exercise duration, or exercise mode is responsible.	B/*
	• Milder forms of exercise (e.g., tai chi, yoga) have shown mixed results.	C/*
	• PA can result in acute improvements in systemic insulin action lasting from 2 to 72 h.	A/*
Chronic effects of exercise training	• Both aerobic and resistance training improve insulin action, blood glucose control, and fat oxidation and storage in muscle.	B/*
	• Resistance exercise enhances skeletal muscle mass.	A/*
	• Blood lipid responses to training are mixed but may result in a small reduction in LDL cholesterol with no change in HDL cholesterol or triglycerides. Combined weight loss and PA may be more effective than aerobic exercise training alone on lipids.	C/*
	• Aerobic training may slightly reduce systolic blood pressure, but reductions in diastolic blood pressure are less common, in individuals with type 2 diabetes.	C/*
	• Observational studies suggest that greater PA and fitness are associated with a lower risk of all-cause and cardiovascular mortality.	C/*
	• Recommended levels of PA may help produce weight loss. However, up to 60 min/day may be required when relying on exercise alone for weight loss.	C/*
	• Individuals with type 2 diabetes engaged in supervised training exhibit greater compliance and blood glucose control than those undertaking exercise training without supervision.	B/*
	• Increased PA and physical fitness can reduce symptoms of depression and improve health-related quality of life in those with type 2 diabetes.	B/*
PA and prevention of type 2 diabetes	• At least 2.5 h/week of moderate to vigorous PA should be undertaken as part of lifestyle changes to prevent type 2 diabetes onset in high-risk adults.	A/A
PA in prevention and control of gestational diabetes mellitus	• Epidemiological studies suggest that higher levels of PA may reduce risk of developing gestational diabetes mellitus during pregnancy.	C/*
	• Randomized controlled trials suggest that moderate exercise may lower maternal blood glucose levels in gestational diabetes mellitus.	B/*
Preexercise evaluation	• Before undertaking exercise more intense than brisk walking, sedentary persons with type 2 diabetes will likely benefit from an evaluation by a physician. Electrocardiogram exercise stress testing for asymptomatic individuals at low risk of coronary artery disease is not recommended but may be indicated for higher risk.	C/C

(continued)

Table 2—*Continued*

	ACSM evidence and ADA clinical practice recommendation statements	ACSM evidence category (A, highest; D, lowest)/ ADA level of evidence (A, highest; E, lowest)
Recommended PA participation for persons with type 2 diabetes	• Persons with type 2 diabetes should undertake at least 150 min/week of moderate to vigorous aerobic exercise spread out over at least 3 days during the week, with no more than 2 consecutive days between bouts of aerobic activity.	B/B
	• In addition to aerobic training, persons with type 2 diabetes should undertake moderate to vigorous resistance training at least 2–3 days/week.	B/B
	• Supervised and combined aerobic and resistance training may confer additional health benefits, although milder forms of PA (such as yoga) have shown mixed results. Persons with type 2 diabetes are encouraged to increase their total daily unstructured PA. Flexibility training may be included but should not be undertaken in place of other recommended types of PA.	B/C
Exercise with nonoptimal blood glucose control	• Individuals with type 2 diabetes may engage in PA, using caution when exercising with blood glucose levels exceeding 300 mg/dl (16.7 mmol/l) without ketosis, provided they are feeling well and are adequately hydrated.	C/E
	• Persons with type 2 diabetes not using insulin or insulin secretagogues are unlikely to experience hypoglycemia related to PA. Users of insulin and insulin secretagogues are advised to supplement with carbohydrate as needed to prevent hypoglycemia during and after exercise.	C/C
Medication effects on exercise responses	• Medication dosage adjustments to prevent exercise-associated hypoglycemia may be required by individuals using insulin or certain insulin secretagogues. Most other medications prescribed for concomitant health problems do not affect exercise, with the exception of β-blockers, some diuretics, and statins.	C/C
Exercise with long-term complications of diabetes	• Known cardiovascular disease is not an absolute contraindication to exercise. Individuals with angina classified as moderate or high risk should likely begin exercise in a supervised cardiac rehabilitation program. PA is advised for anyone with peripheral artery disease.	C/C
	• Individuals with peripheral neuropathy and without acute ulceration may participate in moderate weight-bearing exercise. Comprehensive foot care including daily inspection of feet and use of proper footwear is recommended for prevention and early detection of sores or ulcers. Moderate walking likely does not increase risk of foot ulcers or re-ulceration with peripheral neuropathy.	B/B
	• Individuals with cardiac autonomic neuropathy should be screened and receive physician approval and possibly an exercise stress test prior to exercise initiation. Exercise intensity is best prescribed using the heart rate reserve method with direct measurement of maximal heart rate.	C/C
	• Individuals with uncontrolled proliferative retinopathy should avoid activities that greatly increase intraocular pressure and hemorrhage risk.	D/E
	• Exercise training increases physical function and quality of life in individuals with kidney disease and may even be undertaken during dialysis sessions. The presence of microabuminuria per se does not necessitate exercise restrictions.	C/C
Adoption and maintenance of exercise by persons with diabetes	• Efforts to promote PA should focus on developing self-efficacy and fostering social support from family, friends, and health care providers. Encouraging mild or moderate PA may be most beneficial to adoption and maintenance of regular PA participation. Lifestyle interventions may have some efficacy in promoting PA behavior.	B/B

*No recommendation given.

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