

# Case Study: Aerobic Exercise Training Improves Cardiovascular Disease Risk in a 71-Year-Old Woman With Type 2 Diabetes

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## PRESENTATION

B.C. is a 71-year-old sedentary, African-American woman who has been living with type 2 diabetes for 10 years. Her medical history includes stroke, valve prolapse, restless leg syndrome, and hip replacement. There is no family history of diabetes or symptoms at presentation. B.C.'s baseline weight is 160.8 lb, and her waist circumference is 99 cm. Resting blood pressure is 144/68 mm Hg. She is currently taking metformin, glyburide, simvastatin, and gabapentin. Baseline laboratory analyses reveal a fasting blood glucose of 303 mg/dl, A1C of 9.9%, C-reactive protein of 1.6 mg/dl, total cholesterol of 205 mg/dl, LDL cholesterol of 144 mg/dl, total cholesterol-to-HDL cholesterol ratio of 4.8,  $VO_{2max}$  of 15.6 ml/kg/min, systolic blood pressure of 144 mm Hg, and percent body fat of 40. Her daily physical activity consists of low-intensity walking and housework for < 30 minutes per day.

B.C. enrolls in a 12-week supervised aerobic exercise program. After a preliminary screening consisting of height, weight, waist-to-hip ratio, systolic and diastolic blood pressures, and cardiovascular disease risk assessment, B.C. reports to the general clinical research center for pre- and posttraining 12-hour fasting blood draws, body composition assessment (dual-energy X-ray absorptiometry), and maximal exercise testing (treadmill with indirect calorimetry). B.C. receives clearance

from her physician before beginning the exercise training.

## QUESTIONS

1. What type of exercise program should be prescribed for B.C.?
2. What outcomes might be expected from the 12-week exercise program?
3. Can the risk factors for cardiovascular disease be lowered with a 12-week exercise program in a 71-year-old woman with type 2 diabetes?

## COMMENTARY

Because B.C. was not currently meeting the U.S. Surgeon General's recommendations for physical activity,<sup>1</sup> she was placed on a 12-week training program with a frequency of 3 days per week for a duration of 30 minutes/day. The mode was self-selected exercise, consisting of treadmill walking and recumbent stationary cycling. Training intensity was set at 50–85%  $VO_{2peak}$  as recorded during maximal exercise testing. Warmup consisted of 5 minutes of light-intensity walking on a treadmill.

B.C. wore a heart rate monitor (Polar Electro, Finland) and her heart rate was recorded every 5 minutes. Rating of perceived exertion was recorded every 10 minutes. She was closely monitored and encouraged by an exercise physiologist during each training session, which

took place at a fitness center on a medical school campus.

Blood glucose and blood pressure were measured before and after each exercise bout. She was instructed to consume a light snack 30–60 minutes before exercise. Pre-exercise blood glucose was checked to verify that it was between 100 and 250 mg/dl, in the absence of hypo- or hyperglycemic symptoms.<sup>1</sup> On one occasion, B.C. arrived at the exercise facility with a blood glucose reading of 290 mg/dl and for safety reasons was not permitted to exercise that day. In addition, B.C. was monitored postexercise to verify that her blood glucose was > 70 mg/dl; lower readings are indicative of exercise-induced hypoglycemia. There were no occurrences of hypoglycemia.

Posttraining laboratory analyses revealed the following values: fasting blood glucose of 181 mg/dl, A1C of 9.2%, C-reactive protein of 1.1 mg/dl, total cholesterol of 178 mg/dl, LDL cholesterol of 114 mg/dl, total cholesterol-to-HDL cholesterol ratio of 4.1, systolic blood pressure of 114 mm Hg,  $VO_{2max}$  of 16.8 ml/kg/min, and percent body fat of 37.6 (Table 1). Training compliance was 100%. She remained on metformin and glyburide.

After 12 weeks of moderate-intensity exercise, B.C. decreased five risk factors for cardiorespiratory disease: percent body fat, fasting glucose, LDL cholesterol, systolic blood pressure, and sedentary life-

**Table 1. Changes in Cardiovascular Disease Risk After 12 Weeks of Aerobic Exercise Training**

	Pretraining	Posttraining	Change (%)
C-reactive protein (mg/dl)	1.6	1.1	−31
Fasting glucose (mg/dl)	303	181	−40
A1C (%)	9.9	9.2	−0.7
Total cholesterol (mg/dl)	205	178	−13
LDL cholesterol (mg/dl)	144	114	−21
TC/HDL ratio	4.8	4.1	−14.6
Systolic blood pressure (mm Hg)	144	114	−21
Diastolic blood pressure (mm Hg)	68	56	−18
Pulse pressure (mm Hg)	76	58	−24
Max systolic blood pressure	196	188	−4
Systolic blood pressure recovery*	164	144	−12
Cardiorespiratory fitness (ml/kg/min)	15.6	16.8	+8
Body fat (%)	40	37.6	−2.4
Waist circumference (cm)	99	97	−2

\*Measured at minute 3 after termination of the exercise test.

style. Additionally, her C-reactive protein and A1C were lowered, while her maximum aerobic capacity was increased. The improved lipid profile was especially crucial, considering that the combination of dyslipidemia and diabetes magnifies the risk for cardiovascular disease.<sup>2</sup> The post-training LDL cholesterol value of 114 mg/dl represented a substantial improvement in her targeted LDL value that was not possible with therapeutic agents alone.

Another major change for B.C. as a result of the exercise training was the 40% decrease in fasting blood glucose. Although still higher than the recommended preprandial blood glucose values of 70–130 mg/dl,<sup>2</sup> B.C. was able to improve her glycemic control to a greater degree after including walking and stationary cycling to her diabetes treatment plan. The mechanism for her improved glycemic control may have been achieved through the changes

in body composition, specifically reductions in percent body fat.<sup>3</sup>

B.C.'s 0.7% reduction in A1C is comparable to the 0.66% reported in a meta-analysis on exercise training and glycemic control in type 2 diabetic patients.<sup>4</sup> Decreases in A1C have been shown to be related to exercise intensity: reductions of 2.3% have been reported after 8 weeks of cycling at 75%  $\text{VO}_{2\text{max}}$ .<sup>5</sup> The exercise intensity of the current study ranged from 50 to 85%  $\text{VO}_{2\text{peak}}$ ; however, given B.C.'s history with hyperglycemia, lowering her A1C to the recommended level of < 7.0%<sup>2</sup> will probably require continued or additional medication. Also, the expected improvement in glycemic control may have been limited by the 12-week duration of the study, since A1C and fasting glucose levels may not have reached their lowest end points.

B.C. was aware that she needed to make lifestyle changes, especially after her hip replacement surgery. As

a septuagenarian with diabetes, she faced an increased risk of functional disability, premature death, and cognitive impairment compared to older women without diabetes.<sup>2</sup> Further, the majority of older women with type 2 diabetes also report comorbidities such as stroke, heart failure, myocardial infarction, and nephropathy.<sup>6</sup>

Injuries and subsequent disability related to falling are also more prevalent with increasing age and lack of physical activity.<sup>7</sup> Older adults with diabetes also face an increased fall risk due to peripheral neuropathy and poor vision. Improving glycemic control has been shown to reduce fall risk.<sup>8</sup>

Exercise interventions involving septuagenarian women with type 2 diabetes are limited. In one study, patients with type 2 diabetes (aged 55–75 years) showed no differences in insulin sensitivity after a 12-week aerobic exercise training program, despite lower triglyceride and LDL cholesterol levels.<sup>9</sup> It is important to note that patients in B.C.'s situation should obtain cardiac clearance before initiating a moderate-intensity exercise program.

## CLINICAL PEARLS

Septuagenarian women with type 2 diabetes can improve their glycemic control through moderate aerobic exercise training.

Twelve weeks of aerobic exercise reduced the blood pressure, blood lipids, body fat, and C-reactive protein levels in a 71-year-old woman with type 2 diabetes.

A supervised aerobic exercise program can be prescribed safely for older women with type 2 diabetes.

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