

Daily movement and physical activity

An important part of managing type 2 diabetes

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A diagnosis of type 2 diabetes can be a strong motivator of health behaviour change and provides a key opportunity for reducing sedentary behaviour and for prescribing physical activity that is carefully tailored to an individual patient.

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The incidence of type 2 diabetes continues to rise steadily in Australia and worldwide, with obesity and physical inactivity being key drivers of the increase. The American Diabetes Association currently recommends treatment for patients with type 2 diabetes to achieve optimal blood glucose

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(HbA_{1c} <53 mmol/mol [7%]), lipid and blood pressure levels.¹ These treatment goals are typically approached with a combination of medication, dietary modification and exercise.² Although medication and dietary modification are generally understood by patients and health practitioners, a specific exercise prescription, and its potential clinical responses and benefits, may be less well understood and thus not fully exploited.

EXERCISE AND GLUCOSE METABOLISM

Acute exercise results in immediate reductions in circulating blood glucose. Muscles become more sensitive to lower insulin levels (through enzyme up-regulation and translocation of glucose transporters) and, importantly, exercising muscles also act to increase glucose uptake independently of insulin.^{2,3} Both of these mechanisms are crucial for patients with type 2 diabetes, with regular, well-planned exercise having been shown to be equivalent to adding hypoglycaemic medication for reducing blood glucose levels.^{4,5}

Long-term studies have shown that exercise training has multiple benefits in patients with type 2 diabetes.^{2,6,7} These include reductions in body weight, fasting glucose level, fasting insulin level and whole-body insulin resistance, rate of fat oxidation, hepatic lipid accumulation, blood cholesterol level and blood pressure. Exercise training also increases cardiorespiratory fitness in individuals with type 2 diabetes.^{2,6,7} Several long-term intervention trials^{8,9} and meta-analyses^{5,7,10-12} have identified significant and clinically meaningful ($\geq 0.66\%$) reductions in HbA_{1c} with structured exercise interventions. Notably, many of these analyses show HbA_{1c} reductions that are independent of body weight change.

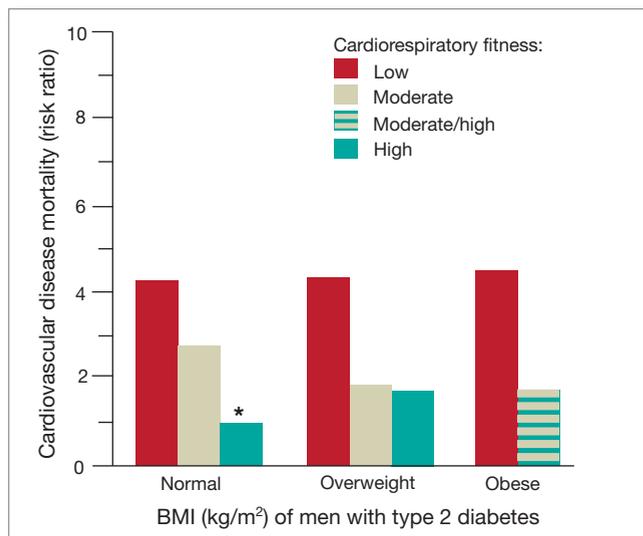


Figure 1. A low level of cardiorespiratory fitness has been shown to be associated with an increased risk of death due to cardiovascular disease in men with type 2 diabetes of three weight categories: normal weight (BMI 18.5 to 24.9 kg/m²), overweight (BMI 25.0 to 29.9 kg/m²) and class 1 obese (BMI 30.0 to 34.9 kg/m²). This study comprised 2316 men with type 2 diabetes at baseline, 179 of whom died of cardiovascular disease during the study. Asterisk denotes reference category (risk ratio = 1.0). Mean risk ratios are adjusted for age and examination year.

Adapted from: Church TS, et al. Arch Intern Med 2005; 165: 2114-2120.¹³

THE IMPORTANCE OF PHYSICAL FITNESS

Physical inactivity and, to a considerable extent, low physical fitness are strong predictors of cardiovascular and all-cause mortality – an association that appears to be independent of body weight.^{12,13-15} In a prospective study of patients with type 2 diabetes, obese men who were highly or moderately fit were found to have almost half the risk of mortality due to cardiovascular disease compared with men of normal weight who were unfit (Figure 1).^{13,16}

PRESCRIBING EXERCISE FOR PATIENTS WITH TYPE 2 DIABETES

What type of exercise?

Both aerobic and resistance (strength) exercise impart similar glycaemic benefits in patients with type 2 diabetes; however, combining the two types of exercise appears to provide additional benefit

beyond doing either alone.¹ Resistance exercise is particularly important for frail and/or elderly patients who have diabetes.¹⁷ The effects of increased insulin action and glucose tolerance disappear within about 48 hours, highlighting the need for exercise regularity – that is, less than two days between exercise sessions.^{2,11}

Reviews of multiple studies suggest that exercise intensity, volume and ultimately adherence are important components of the exercise prescription.^{5,7,11,12} However, because many intervention trials have combined aerobic, resistance and mixed exercise types, it is still unclear which exercise type provides superior clinical benefit.¹⁸ There is still much to be uncovered in this area, but an exercise prescription ultimately needs to be tailored to each individual patient, allowing for cardiovascular and functional/musculoskeletal complications.

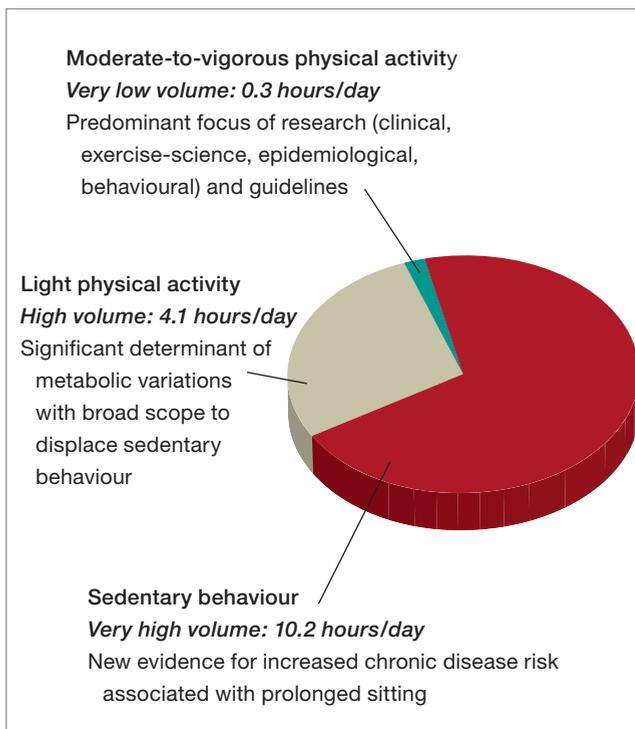


Figure 2. Average waking time spent sedentary and in physical activity (light intensity and moderate-to-vigorous intensity) by Australian adults, as measured by accelerometer.

Findings from: Healy GN, et al. Diabetes Care 2008; 31: 369-371.¹⁹

Reducing sedentary behaviour

Strategies for reducing sedentary behaviour – too much sitting as distinct from too little exercise – should be part of the exercise prescription. It has been shown that adults spend up to about 70% of their waking hours sedentary – that is, sitting (Figure 2).¹⁹ Several large-scale epidemiological observational studies, together with recent findings from controlled laboratory experiments, have identified distinct metabolic and health-related effects of prolonged sitting.²⁰⁻²² Imposed bouts of prolonged sitting acutely reduce insulin sensitivity and increase triglyceride levels, possibly due to reductions in lipoprotein lipase and glucose transport protein activity in skeletal muscle.^{23,24}

In a recent randomised crossover trial involving inactive overweight adults, significant attenuations in post-meal plasma glucose and serum insulin levels were shown with two-minute walking

breaks every 20 minutes compared with uninterrupted sitting.²² Although these results show promise for metabolic health, such experimental findings are yet to be verified in patients with type 2 diabetes – who could derive the greatest benefits.

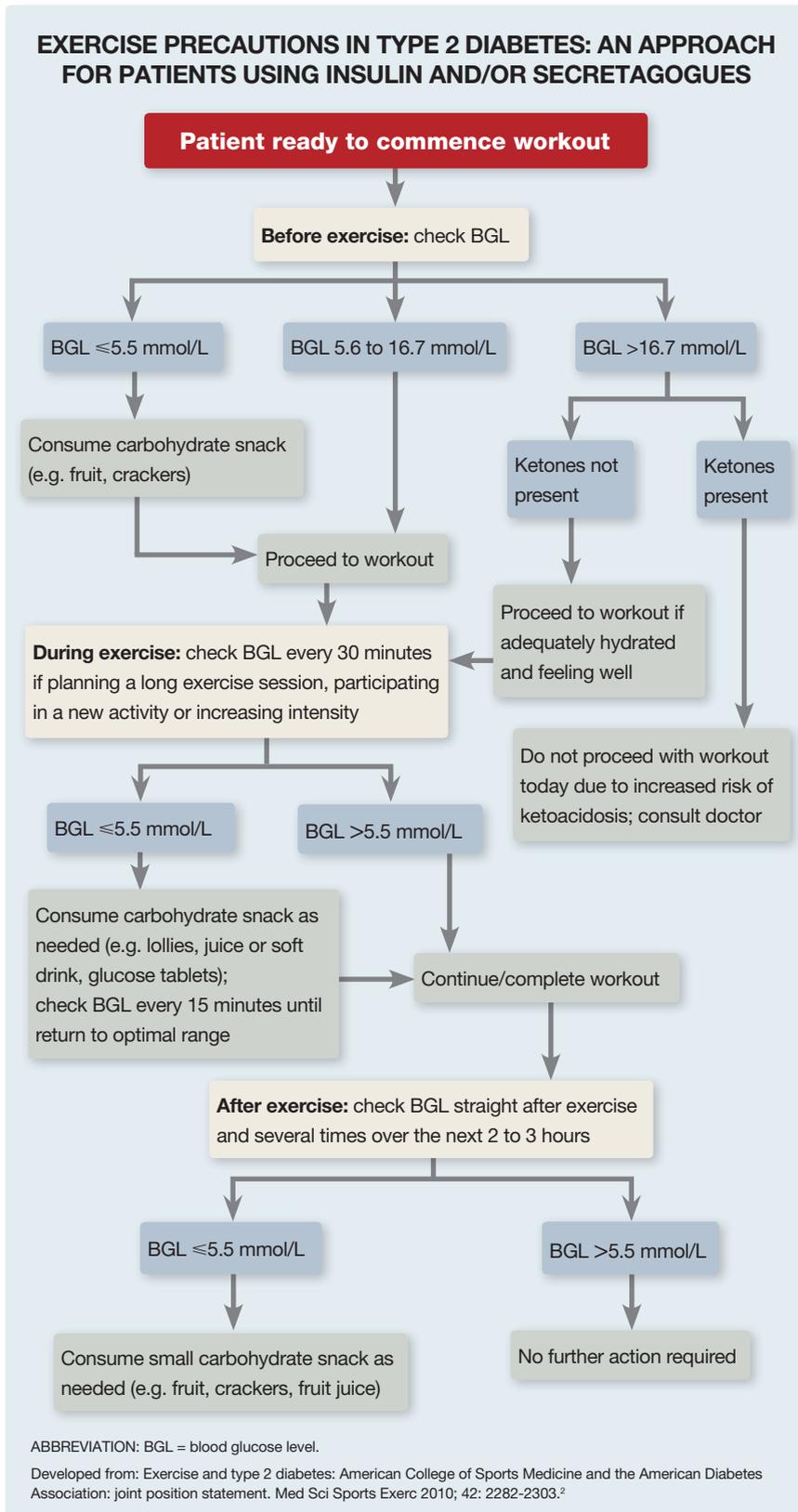
Patients should be encouraged to create opportunities to limit their sitting time (at home and work and during transportation) and to include frequent transitions from sitting to standing and walking throughout the day. Light intensity activities occupy a large portion of the waking day (Figure 2),¹⁹ but until recently these have been given limited consideration as a potential source of benefit in patients with type 2 diabetes.

Combining exercise and pharmacotherapy

There are several classes of hypoglycaemic medications, with each drug class targeting a specific dysregulated process. Since insulin and exercise evoke separate mechanisms that beneficially influence glucose uptake, they can additively decrease the circulating glucose level, particularly if insulin levels peak at the same time as exercise. Consequently, the type and timing of some medications can affect glycaemic responses.

Patients who are taking insulin and/or insulin secretagogues (sulfonylureas) can be at increased risk of developing hypoglycaemia with exercise. However, metformin, dipeptidyl peptidase-4 (DPP-4) inhibitors and glucagon-like peptide-1 (GLP-1) receptor agonists do not cause hypoglycaemia unless combined with insulin or sulfonylurea therapy.^{2,25} Current guidelines include monitoring blood glucose levels before exercise (and ingesting carbohydrate as needed) and then during exercise (sometimes) and again after exercise.² Patients may also need to reduce their oral medications or insulin dosing before, and possibly after, exercise.

The flowchart outlines an approach to managing this risk for patients with non-optimal blood glucose control who are taking insulin and/or secretagogues.



EXERCISE AND TYPE 2 DIABETES: HELPING PATIENTS GET STARTED

Exercise prescriptions for patients with type 2 diabetes need to be tailored to each individual, allowing for cardiovascular and functional/musculoskeletal complications. Exercise intensity, volume and ultimately adherence are important components. Prescribing low intensity exercise and/or light physical activity initially can help to avoid dropout and injury.

Patients who were previously sedentary or have advanced diabetes complications (e.g. eye problems, nerve damage) should be evaluated by their doctor prior to commencing an exercise program; this should include an assessment of medications. Initial instruction and periodic supervision by a qualified exercise trainer is recommended, particularly with resistance exercise training, to minimise injury risk and monitor glucose control and cardiovascular risk.

Moderate walking does not increase the risk of foot ulcers/re-ulceration in patients with peripheral neuropathy. However, comprehensive foot care (including daily inspection of feet and the use of proper footwear) is recommended for the prevention and early detection of sores or ulcers.

A five-minute warm up and warm down before and after exercise is suggested to minimise adverse events and injury risk. Patients should avoid exercising for long periods in hot conditions (due to the increased dehydration risk).

Aerobic exercise training

- Aim to accumulate more than 30 minutes of moderate intensity activity on five days each week. Examples include fast walking or cycling, swimming or aqua jogging and circuit training (at approximately 40 to 60% of maximum effort).

Resistance exercise training

- Include resistance activities on two or three days per week.
- Aim to include five to 10 different movements targeting the major muscle groups of the upper and lower body, with enough resistance (e.g. hand, free or fixed weights or body weight) to perform eight to 10 repetitions (10 to 15 for the frail elderly) to near fatigue.
- Slowly work towards achieving three or four sets per movement.

Lifestyle and sedentary behaviour changes: a 'whole-of-day' approach

- Aim to stand up more, sit less and move more, more often. Create opportunities to limit sitting time and encourage enjoyable activities that will be sustainable.

Adapted from: Exercise and type 2 diabetes: American College of Sports Medicine and the American Diabetes Association: joint position statement. *Med Sci Sports Exerc* 2010; 42: 2282-2303.²

RECENT CLINICAL OUTCOME STUDIES

Findings from a large lifestyle intervention trial ('Look AHEAD') have recently added to the debate regarding the benefits of exercise and diet in the modern management of type 2 diabetes.²⁶ In this trial, 5145 overweight or obese participants with type 2 diabetes were randomised to receive either an 'intensive' lifestyle modification program (treatment group) or diabetes education and counselling (control group). Participants in the treatment group, who moderately exercised for 175 minutes per week and consumed 1200 to 1800 calories, managed to significantly reduce their weight,

waist circumference, blood pressure and HbA_{1c} while also improving their fitness, microvascular outcomes and quality of life, compared with those in the control group. There was, however, no effect on cardiovascular endpoints.

In contrast, a recent analysis of the ADVANCE factorial randomised controlled trial showed evidence of reduced incidence of cardiovascular events, microvascular complications and all-cause mortality in patients with type 2 diabetes undertaking moderate/vigorous physical activity for more than 15 minutes per week.²⁷ Although this trial was the largest

to date and was well characterised (11,140 older/overweight participants with type 2 diabetes), the self-reporting of physical activity levels (at baseline only), which is prone to recall and response bias, was a limitation of the design.

FINAL POINTS

There is strong evidence supporting exercise as a cornerstone in the treatment of type 2 diabetes. However, debate still exists surrounding certain mechanisms of effect and ultimate cardiovascular benefits.

- Exercise training in patients with type 2 diabetes helps control blood glucose levels and blood pressure, reduces microvascular complications and premature mortality, increases physical fitness, function and independence, and improves quality of life.
- Physical activity can be prescribed in many forms – aerobic exercise, resistance training and unstructured lifestyle physical activities. Some useful tips based on current recommendations are given in the box on this page.
- There is increasing evidence that breaking up periods of prolonged sitting is metabolically beneficial.

Current guidelines support the concept that diabetes care, including medications, weight reduction and exercise, be tailored to suit individual patients.¹ Exercise schedules should be tailored according to comorbidity, functional status and current medications. The involvement of an exercise physiologist should be considered to optimise team care arrangements and exercise programs. A diagnosis of type 2 diabetes can be a strong motivator of health behaviour change, and health professionals and their patients should heed this opportunity. **MT**

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A list of references is included in the website version (www.medicinetoday.com.au) and the iPad app version of this article.

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