

## Exercise therapy in type 2 diabetes

*In this section, a panel of multidisciplinary team members give their opinions on a recently published paper. In this issue, we focus on the contribution of exercise to the management of type 2 diabetes and the impact of the frequency of exercise on glycaemic control.*

**Exercise therapy in type 2 diabetes: is daily exercise required to optimize glycaemic control?**

van Dijk JW, Tummers K, Stehouwer CD et al (2012) *Diabetes Care* 35: 948–54

### DIABETES CARE

#### Daily exercise does not further improve glycaemia compared with exercise every other day

**1** In this study the authors aimed to investigate the impact of daily exercise versus exercise performed every other day on glycaemia in people with T2D.

**2** People with T2D ( $n=30$ ; aged  $60\pm 1$  years; mean BMI  $30.4\pm 0.7$  kg/m<sup>2</sup>; mean HbA<sub>1c</sub> 7.2% [55 mmol/mol]) were recruited to participate in this randomised crossover experiment.

**3** Participants were studied on three occasions for 3 days under strict dietary standardisation, but otherwise free-living conditions. Glycaemia was assessed by continuous glucose monitoring, during which participants undertook: (i) no exercise (control); or (ii) a single 60-minute cycling session at 50% maximal workload capacity performed every other day; or (iii) a single 30-minute cycling session at 50% maximal workload performed daily.

**4** Fasting plasma glucose and insulin concentrations were assessed on the first day of each intervention and did not differ between treatments; post-breakfast plasma glucose and insulin concentrations on day 1 showed a dose-dependent effect after performing 30

and 60 minutes of exercise, respectively (both  $P<0.001$ ).

**5** Hyperglycaemia (blood glucose  $>10$  mmol/L) was reduced from  $7:40\pm 1:00$  h:min per day to  $5:46\pm 0:58$  and  $5:51\pm 0:47$  h:min per day when exercise was performed either daily or every other day, respectively (both  $P<0.001$ ); no difference in impact between the exercise arms was found.

**6** The authors concluded that a 30-minute session of moderate-intensity, endurance-type exercise substantially reduces the prevalence of hyperglycaemia throughout the subsequent day in people with T2D; when total work is being matched, daily exercise does not further improve daily glycaemia compared with exercise performed every other day.

**“The study is somewhat complicated by participants receiving a variety of treatment modalities – from diet alone, through to insulin pump therapy – which makes extrapolation of the results in this mixed population somewhat difficult.”**



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**E**xercise has been proposed as a treatment for type 2 diabetes, with purported improvements in glycaemic control through increased insulin sensitivity (Ivy, 1997). Exercise has the potential not only to improve glycaemic control, but also to control weight, and improve cardiovascular fitness and psychological well-being – at low cost, and with low risk of adverse effects.

Structured exercise interventions of at least 8 weeks' duration have been shown to lower HbA<sub>1c</sub> by an average of 0.66 percentage points in people with type 2 diabetes, and higher levels of exercise intensity are associated with greater improvements in HbA<sub>1c</sub> and fitness (Boulé et al, 2001). A joint position statement by the American Diabetes Association and the American College of Sports Medicine (Colberg et al, 2010) suggests that people with type 2 diabetes should undertake at

least 150 minutes per week of moderate to vigorous aerobic exercise spread out over at least 3 days during the week, with no more than two consecutive days between bouts of aerobic activity. In addition to aerobic training, persons with type 2 diabetes should undertake moderate to vigorous resistance training at least 2–3 days/week.

However, compliance with regular exercise may be poor. Patients frequently cite time and inconvenience as reasons not to increase exercise. The study by van Dijk et al (2012; summarised above) investigated whether short periods of daily exercise may be as effective in improving glycaemic control as longer periods of exercise on alternate days. They found that, when the total activity is being matched, daily exercise does not further improve daily glycaemia compared with exercise performed every other day. As might be expected, hypoglycaemia was three times more frequent in those participants receiving insulin therapy, but the prevalence of hypoglycaemia was not increased by either type of exercise for the rest.

The study shows that postprandial hyperglycaemia remains a significant problem among those with apparently reasonably well-controlled type 2 diabetes, and that exercise significantly reduces the burden of hyperglycaemia without increasing the risk of hypoglycaemia.

The study is somewhat complicated by participants receiving a variety of treatment modalities – from diet alone, through to insulin pump therapy – which makes extrapolation of the results in this mixed population somewhat difficult. Furthermore, this study was of a short duration (3 days) and it will be important to determine in further investigations whether the metabolic benefits of exercise identified here are maintained and increased in the long term. The total weekly workout time (210 minutes) suggested by this study is more than that suggested by current guidance (150 minutes; Colberg et al, 2010), but could incorporate travel to work or other activities of daily living.

Clinicians can use these data to encourage people with type 2 diabetes to increase their exercise, with the advice that shorter periods of daily exercise are as effective in improving glycaemic control as longer periods on alternate days. We know that exercise works; the challenge is to get people to do more!

Boulé NG, Haddad E, Kenny GP et al (2001) Effects of exercise on glycemic control and body mass in type 2 diabetes mellitus: a meta-analysis of controlled clinical trials. *JAMA* 286(10):1218-27.

Colberg SR, Sigal RJ, Fernhall B et al (2010) Exercise and type 2 diabetes: the American College of Sports Medicine and the American Diabetes Association: joint position statement executive summary. *Diabetes Care* 33: 2692–6

Ivy JL (1997) Role of exercise training in the prevention and treatment of insulin resistance and non-insulin-dependent diabetes mellitus. *Sports Med* 24: 321–36



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It is well established that physical activity can improve glycaemic control and insulin sensitivity in people with type 2 diabetes, with this effect lasting for more than 24, but less than 72, hours following a single exercise session. Regular physical activity has also been shown to induce moderate reductions in blood pressure and favourably alter the lipid profile in patients with type 2 diabetes. There is also strong epidemiological evidence to suggest that a high level of physical activity or at least a moderately high level of cardiovascular fitness (a physiological outcome of increased physical activity) reduces risk of cardiovascular and all-cause mortality in patients with type 2 diabetes (Colberg et al, 2010).

In short, increasing physical activity in type 2 diabetes is “a good thing”. Guidance from the American Diabetes Association and American College of Sports Medicine recommends that people with type 2 diabetes

undertake at least 150 minutes of aerobic exercise – typified by brisk walking – over at least three days of the week with no more than two consecutive days between bouts of activity (Colberg et al, 2010).

The rationale for recommending spreading activity throughout the week in this manner is to maximise the window of time of improved glycaemic control and insulin sensitivity. It is possible to meet this recommendation by undertaking activity every other day. But are there additional benefits associated with undertaking physical activity daily, rather than on alternate days? The study by van Dijk and colleagues (2012; summarised opposite) addresses this very issue.

Whether 30 minutes of exercise was undertaken daily, or 60 minutes every other day, average glucose concentrations over the 48-hour observation period were reduced similarly (from  $9.1 \pm 0.4$  mmol/L in the control arm to  $8.3 \pm 0.3$  mmol/L in both exercise arms;  $P < 0.001$  for both). Time spent in a hyperglycaemic state was similarly reduced by both exercise protocols, and neither exercise regimen affected the prevalence of hypoglycaemia.

**“van Dijk et al’s findings suggest that there is some flexibility in how people with type 2 diabetes can choose to incorporate activity into their lives to maximise the beneficial effects on glycaemic control.”**

*Digest Debate continues over page.*

These findings suggest that it is sufficient to undertake physical activity every other day, and that daily exercise does not provide any additional benefits with regard to glycaemic control. This is consistent with the American College of Sports Medicine and the American Diabetes Association (Colberg et al, 2010) guidance for physical activity in people with type 2 diabetes – which can be achieved by being physically active on three non-consecutive days of the week. However, it is important to recognise that the total amount of exercise undertaken in the daily and non-daily exercise arms of van Dijk et al's study were matched (i.e 30 min/day or 60 min every other day), so if physical activity is undertaken every other day, rather than daily, then twice as much activity is required per session to achieve the same result.

Thus, van Dijk et al's findings suggest that there is some flexibility in how people with type 2 diabetes can choose to incorporate activity into their lives to maximise the beneficial effects on glycaemic control – an hour every other day is as good as 30 minutes per day. Knowledge of this equivalency can help people with diabetes and clinicians tailor physical activity programmes to fit in with individual lifestyles.

Colberg SR, Sigal RJ, Fernhall B et al (2010) Exercise and type 2 diabetes: the American College of Sports Medicine and the American Diabetes Association: joint position statement executive summary. *Diabetes Care* **33**: 2692–6

***“We can tell our patients with confidence that, if you are unable to exercise daily, exercise performed every other day will produce similar benefits, as long as the duration of exercise session is doubled.”***



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**T**he recent publication by van Dijk et al (2012; summarised on page 106) examines the impact of exercise on glycaemic control when performed daily, compared with every other day. The study was performed under free-living condition in 30 people with type 2 diabetes, some of whom were receiving insulin therapy.

The authors show that moderate-intensity exercise sessions produced similar reductions in hyperglycaemia, irrespective of whether they were undertaken daily or on alternate days, as long as the “total volume” of exercise was similar.

An important, and perhaps novel, finding of this study is the clear demonstration of a prolonged

period of hyperglycaemia (glucose concentration >10 mmol/L) during a 24-hour period in people with type 2 diabetes who are otherwise relatively well controlled (HbA<sub>1c</sub> 53±2 mmol/mol). This was, on average, 7.40±1.00 hours in both insulin- and non-insulin-treated participants. Whether better control of this prolonged period of hyperglycaemia would lead to further reductions in HbA<sub>1c</sub> remains an intriguing possibility, yet to be confirmed.

The results of this study have practical applications for the clinician offering people with type 2 diabetes lifestyle advice. We can tell our patients with confidence that, if you are unable to exercise daily, exercise performed every other day will produce similar benefits, as long as the duration of exercise session is doubled.