Paediatrics

Physical activity in type 1 diabetes

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Although children are now less active than they were 10 years ago, regular and irregular bouts of physical activity are still part of a healthy childhood. Physical activity is encouraged for children with diabetes yet many problems are encountered. If exercise is performed during a time of relative insulin deficiency, hyperglycaemia with ketosis may occur. If exercise occurs during a time of relative insulin excess, hypoglycaemia may result.

People with diabetes are also at risk of delayed hypoglycaemia many hours later as exercise-depleted muscle glycogen stores are replenished. This risk is probably greatest during the overnight period. Young children may be more at risk as they experience intermittent periods of intense exercise during a normal day, a pattern of activity that has been shown to deplete muscle glycogen stores to a greater extent than continuous exercise.[1]

Most clinics, as well as Diabetes UK and the American Diabetes Association, do offer advice on management of activity involving adjustments to insulin dose, carbohydrate intake or both, but with little supporting evidence for children or adults. So it was refreshing to find a recent 'mini-flurry' of research activity assessing both physical fitness and glycaemic response to activity in childhood diabetes.

Of greatest clinical interest were two studies examining the effect of standardised exercise protocols on blood glucose profiles both acutely and for an extended period of time after exercise. The first of these studies (see right) was performed on behalf of the Diabetes Research in Children Network Study Group. Fifty participants, aged 10–18 years, on intensive insulin regimens were studied on a day of afternoon exercise and a rest day. Individuals performed treadmill exercise for four periods of 15 minutes each at a heart rate estimated to be 55% of maximum effort for this age group. Twenty-two per cent developed hypoglycaemia during exercise despite consuming extra carbohydrate before exercise as required. Overnight hypoglycaemia was more common on an exercise night than a rest night (P=0.009) but 11 participants had overnight hypoglycaemia on both study nights.

The second, smaller study (see below), in a group of children using continuous subcutaneous insulin infusion (CSII), examined glucose profiles if CSII was continued during exercise on a cycle ergometer or if CSII was disconnected during activity. Delayed hypoglycaemia was more common than acute hypoglycaemia during exercise whether CSII was on or off: all individuals had one to three episodes of symptomatic hypoglycaemia 2.5–12 hours after exercise monitored using continuous glucose sensors.

Although these studies add some support to current clinical teaching, many questions remain as to the best way to manage exercise in childhood. The importance of these studies lies in their contribution to the development of an evidence base for the management of exercise in patients with type 1 diabetes. This will allow people to gain the multitude of benefits that regular exercise brings without the attendant risk of upsetting glycaemic control.

[1]Hargreaves M (1995) Skeletal muscle carbohydrate metabolism during exercise. *In:* M Hargreaves, ed. *Exercise Metabolism*. Human Kinetics, Champaign, IL, 41–72

PEDIATRICS

Pumps may not need to be on during prolonged exercise

Readability	✓✓✓✓
Applicability to practice	✓✓✓✓
WOW! factor	✓✓✓✓

1 The aim of the study was to address the lack of clear guidance for children and adolescents on proper adjustment of insulin pumps during exercise.

2 Participants (n=10) were aged between 10 and 19 years, and the exercise consisted of 40–45 min on a cycling machine.

3 Each participant did the period of prolonged exercise on one day with an insulin pump switched on (at 50% of the basal rate) and on another day with it switched off; the order was random.

4 No significant differences were found between having the pump on and having it off for any of the parameters.

5 Given the lack of benefit found in young people with having an insulin pump switched on, the authors recommend that insulin pumps be removed or turned off during unplanned prolonged exercise to avoid the need to change basal rates.

Admon G, Weinstein Y, Falk B et al (2005) Exercise with and without an insulin pump among children and adolescents with type 1 diabetes mellitus. *Pediatrics* **116**(3): e348–55

JOURNAL OF PEDIATRICS

Overnight hypos common after exercise in children with type 1 diabetes

Readability	✓✓✓✓
Applicability to practice	✓✓✓✓
WOW! factor	✓✓✓✓

1 Although regular exercise can have many benefits for children with type 1 diabetes, prolonged physical activity can increase the difficulty associated with blood glucose control.

2 This study was conducted to examine an aspect of this – how does afternoon exercise affect overnight hypoglycaemia in such individuals?

3 Fifty participants with type 1 diabetes (aged between 10 and 18 years) visited one of five clinical research centres on two separate days and did an afternoon exercise test on one of them.

4 Half-hourly blood glucose measurements were made overnight from intravenous catheter samples.

5 Mean blood glucose level between 10 pm and 6 am was found to be significantly lower after the day of exercise (7.3 mmol/l) than after the day of rest (8.6 mmol/l; P=0.003).

6 Moreover, overnight hypoglycaemia (defined as any blood glucose measurement of 3.3 mmol/l or less) occurred significantly more frequently after the day of exercise than after the day of rest (P=0.009) – it happened after exercise only in 13 (26%) cases, after rest only in 3 (6%) cases, after both in 11 (22%) cases and after neither in 23 (46%) cases.

7 The authors note that their findings give weight to the argument for modifying the management of diabetes subsequent to afternoon exercise.

Tsalikian E, Mauras N, Beck RW et al (2005) Impact of exercise on overnight glycemic control in children with type 1 diabetes mellitus. *Journal of Pediatrics* **147**(4): 528–34

PEDIATRIC DIABETES

Impaired aerobic fitness seen in adolescents with type 1 diabetes

Readability	✓✓
Applicability to practice	✓✓✓
WOW! factor	✓✓

1 While physical exercise is recommended as a means of improving glucose uptake in type 1 diabetes, aerobic fitness has been little studied in children with diabetes.

2 Seventy-two individuals with type 1 diabetes (aged from 9 to 20 years) and 46 control participants (aged between 10 and 18 years) underwent an incremental aerobic capacity test on a running machine to assess peak heart rate (HR), time to exhaustion, and gas exchange variables (including peak oxygen consumption [VO_2]).

3 Specific mean values (for those with versus those without type 1 diabetes; ±SE) were as follows: peak HR, 189.23±13.44 versus 195.30±10.22 beats/min ($P<0.05$); time to exhaustion, 8.75±1.60 versus 10.82±1.44 min ($P<0.001$); peak VO_2 41.57±7.68 versus 51.12±9.94 ml/kg/min ($P<0.001$).

4 It is worth noting that HbA_{1c} was significantly higher in those with type 1 diabetes than in the control participants.

5 Overall, those with type 1 diabetes had a lower aerobic capacity than those without.

6 Whether these findings are a physiological consequence of diabetes needs to be determined.

Komatsu WR, Gabbay MA, Castro ML, Saraiva GL, Chacra AR, de Barros Neto TL, Dib SA (2005) Aerobic exercise capacity in normal adolescents and those with type 1 diabetes mellitus. *Pediatric Diabetes* **6**(3): 145–9

ACTA PAEDIATRICA

Normal aerobic fitness seen in prepubertal children with type 1 diabetes

Readability	✓✓✓
Applicability to practice	✓✓✓
WOW! factor	✓✓✓

1 The literature is unclear on differences in physical working capacity between prepubertal children with and without type 1 diabetes.

2 Through an incremental submaximal test, Physical Working Capacity 170 (PWC_{170}) was determined in 17 boys aged 8.5–13 years with type 1 diabetes as well as 18 control participants.

3 Similar mean PWC_{170} values (±SE) were found in individuals with type 1 diabetes (2.28±0.09 watts [W]/kg) and in those without (2.37±0.13 W/kg).

4 The authors suggest that previous discrepancies in the literature may have been due to poor glycaemic control, as this can have a negative effect on physical fitness.

5 In contrast, all participants with diabetes in this study had tight long-term glycaemic control.

Heyman E, Briard D, Gratas-Delamarche A, Delamarche P, De Kerdanet M (2005) Normal physical working capacity in prepubertal children with type 1 diabetes compared with healthy controls. *Acta Paediatrica* **94**(10): 1389–94

'Those with type 1 diabetes had a lower aerobic capacity than those without.'

KIDNEY INTERNATIONAL

Early intervention to reduce GFR may be beneficial

Readability	✓✓✓✓
Applicability to practice	✓✓✓
WOW! factor	✓✓✓

1 This study examined the link between glomerular filtration rate (GFR) at 5 years' diabetes duration and yearly urine albumin excretion in children with type 1 diabetes (n=308).

2 Glomerular hyperfiltration was found to predict microalbuminuria independently of HbA_{1c}, suggesting that it could be another factor in early diabetic nephropathy.

3 The authors use this and other findings to tentatively suggest that early intervention to reduce GFR may benefit poorly controlled children going through puberty prior to the development of frank microalbuminuria.

Amin R, Turner C, van Aken S et al (2005) The relationship between microalbuminuria and glomerular filtration rate in young type 1 diabetic subjects: The Oxford Regional Prospective Study. *Kidney International* **68**(4): 1740–9

'Early intervention to reduce glomerular filtration rate may benefit poorly controlled children going through puberty prior to the development of frank microalbuminuria.'

ARCHIVES OF DISEASE IN CHILDHOOD

Improvements seen in UK health service

Readability	✓✓✓✓
Applicability to practice	✓✓✓
WOW! factor	✓✓✓

1 Since 1998, there have been National Service Framework standards to be met for the care of children with diabetes in the UK.

2 Gradual improvements in services have been noted in three previous national surveys.

3 This fourth survey, carried out by Diabetes UK's Youth and Families Advisory Committee, obtained replies from 187 consultant paediatricians.

4 Continued improvements over the last 4 years have been seen, but serious difficulties remain, especially nurse case-load being too large.

Edge JA, Swift PG, Anderson W et al (2005) Diabetes services in the UK: fourth national survey; are we meeting NSF standards and NICE guidelines? *Archives of Disease in Childhood* **90**(10): 1005–9