Physical Activity

Being physically active every day is important for healthy growth and development. Regular exercise can help maintain a healthy weight, reduce blood pressure and improve blood lipid profile, bone health and self-esteem. A lack of physical activity can mean that your body is less sensitive to the effects of your/your child's insulin injections. Physical activity can include planned activity (e.g. P.E. class) and unplanned activity (e.g. football in the back garden).

How much physical activity should I/my child be doing?

<5 years	**≥3 hours/day**
5-18 years	**≥1 hour/day**
>18 years	**≥150 mins/week**

What happens to blood glucose levels during exercise?

Energy is stored in the body as glycogen (a form of carbohydrate) and fat, mainly in the muscles and liver. During exercise the muscles convert the stored glycogen to glucose for energy, and the liver releases glucose from its stores into the bloodstream. As the blood glucose level rises, the glucose is taken up by the muscles.

In people who do not have diabetes, less insulin is produced during exercise. This is so that the body can match the amount of carbohydrate (carbs) being used by the muscles with the level of glucose (carbs) being released by the liver.

In people with Type 1 diabetes, this reduction in insulin does not occur. The high level of insulin in the blood can reduce the amount of carbs released by the liver, increasing the risk of hypoglycaemia (BG <4 mmol/L).

However, if a person with diabetes exercises when there is not enough insulin in the blood, the muscle cells will signal to the liver to release more glucose into the blood, making the blood glucose levels rise. However, due to the lack of insulin, this glucose can not be used, and fat is broken down instead to create energy, producing ketones.

The BG response to exercise varies from person to person and from sport to sport. Therefore regular BG monitoring is the key to success. Keeping a record of BG, insulin and carbs levels, as well as the timing, duration, type and intensity of sport will help when developing an exercise plan.

How should I manage my/my child's diabetes during physical activity?

Below are some suggestions of ways to help keep blood glucose levels steady and get the most out of exercise sessions.

1. Always check a BG before activity

Exercising with a low or high BG level can affect your performance, and can result in a hypo or high blood ketones. Therefore it is important to check a BG before starting exercise.

BG level before physical activity	Action
<4 mmol/L	Treat hypo and delay exercise.
4-6.9 mmol/L	Take extra carbs. Amount of carbs depends on type and duration of activity.
7-15 mmol/L*	Extra carbs may be required. Amount of carbs depends on type and duration of activity.
>15 mmol/L	Check for ketones. If ketones >0.5 mmol/L exercise should be delayed until additional insulin taken and BG levels have returned to normal. If ketones are not present, start exercise but check BG 30 mins later. After 30 mins if BG levels have: • Decreased; adequate insulin is available and exercise can be continued. • Increased; there is a lack of insulin and you should stop exercising and take extra insulin.

* Optimal BG for performance is 7-8 mmol/L.

2. Take extra carbs without insulin

If you/your child are/is undertaking unplanned or prolonged activity, extra carbs without bolus insulin will be needed. To prevent BG rising too much and to match muscle uptake of glucose it is advisable, if possible, to distribute the carbs throughout the activity. As a guide use the following amounts:

Light Activity	**0.25g carbs per kg per hour**
Moderate Activity	**0.5g carbs per kg per hour**
Vigorous Activity	**1g carbs per kg per hour* (max 60g)**

* If very trained may only need 0.5g carbs/kg.

Example:

Your child is going to play in the garden for **60 minutes** with a friend. Your child weighs **20kg**.
Unplanned activity, so give **extra carbs**.
Light activity, so give **0.25g per kg per hour**.

= 0.25 x 20 = 5g carbs e.g. 5 grapes or 50ml apple juice or 100ml milk

3. Replenish glycogen stores

Every time you exercise, the level of glycogen within the active muscle will decrease. The glycogen stores should be restored before the next exercise session otherwise the quality of the next exercise session may be reduced. The muscles are most effective at replenishing the glycogen stores in the two hours after exercise; therefore carbs should be consumed with insulin during this time at a rate of 1-1.5g carbs per kg per hour of exercise. To help maintain glycogen levels, carbs should be consumed regularly throughout the day.

Glycogen stores can also be depleted after a hypo so it is advisable to postpone strenuous exercise for up to one day after a moderate or severe hypo. The muscles are more sensitive to insulin for up to 24 hours after exercise, so reduced insulin doses and regular BG monitoring is advised during this time. If you do multiple exercise sessions in one day you will be at increased risk of hypoglycaemia for a longer period of time.

4. Reduce the bolus insulin given for a meal before and/or after exercise

If exercising within two hours of a meal bolus, the meal bolus can be reduced. This can be helpful for people who do not want to eat extra snacks. However, some people may find that reducing insulin before exercise results in a high BG, which can affect concentration and performance. If this is the case, taking extra carbs during exercise may be preferred.

Table 1: Guidelines for reducing bolus insulin before and after exercise

Duration (minutes)	Before Light Activity Bolus	After Light Activity Bolus	Before Moderate Activity Bolus	After Moderate Activity Bolus	Before Vigorous Activity Bolus	After Vigorous Activity Bolus
15-30	90%	100%	80%	90%	70%	85%
31-60	75%	90%	70%	80%	50%	70%
>60	70%	80%	50%	60%	35%	50%

Table 2: The easiest way of reducing the bolus insulin dose, is to cover less of the carbohydrate which is being eaten with insulin, as shown in the table below

Carbs	90%	85%	80%	75%	70%	60%	50%	35%
150g	135g	128g	120g	113g	105g	90g	75g	53g
140g	126g	119g	112g	105g	98g	84g	70g	49g
130g	117g	111g	104g	98g	91g	78g	65g	46g
120g	108g	102g	96g	90g	84g	72g	60g	42g
110g	99g	94g	88g	83g	77g	66g	55g	39g
100g	90g	85g	80g	75g	70g	60g	50g	35g
90g	81g	77g	72g	68g	63g	54g	45g	32g
80g	72g	68g	64g	60g	56g	48g	40g	28g
70g	63g	60g	56g	53g	49g	42g	35g	25g
60g	54g	51g	48g	45g	42g	36g	30g	21g
50g	45g	43g	40g	38g	35g	30g	25g	18g
40g	36g	34g	32g	30g	28g	24g	20g	14g
30g	27g	26g	24g	23g	21g	18g	15g	11g
20g	18g	17g	16g	15g	14g	12g	10g	7g
10g	9g	9g	8g	8g	7g	6g	5g	4g

Example

Your child is going to football training for 1 hour from 7-8pm.

Before Activity: For dinner at 5.30pm your child is going to eat 120g of carbs
The usual insulin to carbs ratio at dinner is 1unit to 10g
BG level pre-dinner is 6mmol/L

This is moderate activity, for 60 minutes, 1.5 hours after dinner
Therefore reduce insulin bolus dose for dinner before football

1. Use table 1: give 70% of the usual bolus insulin dose
2. Use table 2: 70% of 120g = 84g

Bolus insulin dose for tea = 84g divided by 10g
= 8.4 units, round to **8.5** units

Please note: The dose of bolus insulin without reduction would have been 120g divided by 10g = 12 units

After Activity: After football training your child needs to replenish his/her glycogen stores

1. The requirement is 1g carbs per kg of body weight per hour of exercise
2. Your child weighs 50kg
3. Therefore your child requires approximately 1 x 50 = 50g carbs

This can be taken either as the next meal if due, or as an additional snack covered with insulin

In this situation, your child will be eating 50g carbs at 8:30pm

- Usual insulin to carbs ratio at this time is 1 unit to 10g
- Pre meal blood glucose level = 6 mmol/L

Moderate activity, for 60 minutes, so reduce insulin bolus dose for this meal after football

1. Use table 1: give 80% of the usual bolus insulin dose
2. Use table 2: 80% of 50g = 40g

Bolus insulin dose for meal after football = 40g divided by 10
= 4 units

Please note: The dose of bolus insulin without reduction would have been 50g divided by 10g = 5 units

5. Consider the type of exercise

Different types of activity can have different effects on BG levels.

Type of exercise	Action
Short sharp, e.g. sprinting (Primarily anaerobic)	Often no decrease in insulin required. Can cause BG to rise and can require more insulin. If BG rises every time before event can consider small bolus, e.g. 25-50% of correction dose before start of event.
Stop/start, e.g. football game (Mix of anaerobic & aerobic)	May require less of a percentage reduction for carbs when calculating bolus dose before and after exercise (see tables on page 3).
Endurance, e.g. cycling for two hours (Primarily aerobic)	A reduction in bolus insulin is required if exercising within two hours of a meal bolus (see tables on page 3). A reduction of basal insulin may also be required (see 'training status' point 6).

6. Consider your/your child's training status

After exercise, muscles can be more sensitive to the effects of insulin for up to 1-2 days. As a result, how often you train/your child trains can have an effect on basal insulin doses, as shown in the table below.

Training Status	Effect on basal insulin dose
Very trained, e.g. 5-7 days/ week	Exercise most nights a week will have the least effect on BG as already on low doses and muscles sensitive to insulin
Moderately trained, e.g. 3-4 nights/ week	Will need some reduction in insulin doses on exercise nights, e.g. 10%
Untrained, e.g. one-off hike	Will need 15-20% reduction in basal insulin

7. Think about which injection site is being used

Exercise increases the absorption of insulin from the injection site if you move that limb during the activity, e.g. injecting into a thigh prior to running. Therefore, try to use an injection site which will have minimal movement during the exercise e.g. inject into tummy before running.

8. Stay well hydrated

Care should be taken to ensure adequate hydration before, during and after exercise.
If your BG level is high before exercise, you may already be dehydrated due to increased urine volumes. During exercise it is important to maintain hydration by drinking water and/or isotonic drinks.

9. Use Isotonic Drinks

Isotonic drinks contain electrolytes (essential salts for the body) and 4-8g carbs per 100ml. The electrolytes help the body to absorb fluid and the carbs provides a small amount of energy during exercise. Suitable commercial drinks include Lucozade Sport, Powerade or Gatorade. Homemade isotonic drinks can be just as effective.

Recipes for Isotonic drinks:

1	2	3
500ml unsweetened fruit juice 500ml water A pinch of salt Mix all ingredients together and chill in fridge (recipe provides approx. 50g carbs per 1 litre)	200ml ordinary fruit squash (NOT sugar-free) 800ml water A pinch of salt Mix all ingredients together and chill in fridge (recipe provides approx. 40-60g carbs per 1 litre)	50-70g Sugar 1 litre warm water A pinch of salt No added sugar squash (for flavour) Mix all ingredients together and chill in fridge (recipe provides approx. 50-70g carbs per 1 litre)

10. Check BG more regularly in hot weather

Warm weather increases blood flow through subcutaneous tissue resulting in faster insulin absorption. This increases your risk of hypoglycaemia. Therefore it is advisable to check your BG regularly in warm conditions.

11. Hypoglycaemia

Due to the increased risk of hypoglycaemia during physical activity you/ your child should always have hypo treatment readily available. Symptoms of hypoglycaemia can be reduced or missed during and/or after physical activity. Therefore, it is advisable to check BG before activity, every 30 minutes during activity and hourly for a few hours afterwards. The lowest BG often occurs between midnight and 3am (or 7-11 hours after exercise) so it is advisable to set an alarm to check BG at this time after vigorous activity.

Further information

www.runsweet.com

This website provides information for athletes with type 1 diabetes