

## Department of Nutrition and Dietetics

# Physical activity and insulin: Type 1 Diabetes

Physical activity forms a very important part of the treatment of diabetes, and research has shown it to have both short and long term benefits on blood glucose control. It is recommended that everyone living with diabetes takes regular physical activity – whatever their age and level of health.

Physical activity will affect the way your body uses glucose and insulin, and therefore can affect your blood glucose levels in different ways. This information aims to help you understand what is happening to your body during activity and provide you with some guidance on how you can adjust your diet and insulin to maintain stable blood glucose levels both during and after your exercise.

Everyone will react differently to exercise. It is therefore important to monitor your blood sugars regularly during and after exercise to see how your own body reacts to your chosen exercise. **Also, whatever you are doing, make sure you have some hypo treatment to hand in case your blood sugars drop unexpectedly during your activity.**

### What happens when I exercise?

During exercise, your body requires fuel, which is provided by carbohydrate, fat and protein in your diet. The most important fuel for your muscles is carbohydrate, which is broken down into glucose. In order for your muscles to use glucose, insulin is required.

The body uses different sources of fuel depending on the length and intensity of the exercise. When exercise starts, the body uses glucose stored as glycogen in the muscles for fuel. These stores are depleted very quickly and the body then starts to use glucose from the blood stream. The glucose in the blood is topped up by supplies of glucose from the liver. Insulin is required throughout this process to allow the muscles to use the glucose for fuel. As the duration of exercise increases, the body can use fat stores for energy.

### What are the effects of exercise on my blood glucose levels?

Your blood glucose management with physical activity will depend on the amount and timing of carbohydrate that you eat or drink the level of insulin in your blood and the intensity and duration of your activity.



## Patient Information

### **A low blood glucose level (hypoglycaemia) can be caused by**

- Eating too little carbohydrate to sustain the activity
- Starting the activity when your blood glucose level is already low
- Too much insulin, which prevents the liver from releasing glucose into the blood
- Increase in insulin absorption if an injection is given or a pump cannula is sited in a limb that is exercised (e.g. a thigh when running or cycling)
- A hypo within the last 24 hours makes a hypo during exercise more likely.

### **A high blood glucose level (hyperglycaemia) can be caused by**

- A lack of insulin, which prevents the muscles from taking up glucose from the bloodstream, and may lead to the production of ketones
- Anaerobic, high intensity activity such as weight lifting or sprinting
- Presence of adrenaline, which inhibits the action of insulin – this could arise in a competitive sporting situation.

It has been found that the body is more sensitive to insulin after physical activity or exercise. Glycogen stores in liver and muscle need to be replenished as well. Both of these factors can lead to low blood glucose levels or hypos in the hours and days after the activity.

### **How can I prevent these effects?**

To manage blood glucose levels around exercise, you can have extra carbohydrate to match the amount used up during exercise, and/or change the amount of insulin that is active during the exercise. Frequent blood glucose monitoring will help you to see how your body responds to the type and duration of your activity.

### **Preparing for activity – adjusting insulin**

The best time to exercise is around two hours after a meal when you still have active insulin working. If it is more than four hours since your last insulin injection or bolus then your blood glucose may rise due to lack of insulin.

**If you are on a mixed (biphasic) insulin** you should not adjust your insulin, but instead you should eat or drink enough carbohydrate to support the activity.

**If you are on a basal bolus insulin regime** – if you eat around two hours before exercising, you can reduce your insulin dose at this meal by between 25-75% to help prevent low blood glucose levels.

You may also choose to reduce your long-acting insulin dose by 25-50% if you know you are going to be unusually active all day, if your activity is likely to be strenuous, and especially if you will be exercising the next day – on an activity holiday, for example.

**If you use an insulin pump** then you can also use a TBR (temporary basal rate) to reduce the amount of background insulin to prevent low blood glucose. Start your basal reduction 60-90 minutes before exercise that lasts 60 minutes or longer. If you have problems with hypoglycaemia after exercise, continue the reduced basal rate as necessary.

## Patient Information

### Just before starting activity

Before starting, check your blood glucose level.

Blood glucose level	Can I exercise?
Lower than 7mmol/L	Consume 15-20g carbohydrate before starting. At this level you are at risk of a hypo during your exercise if you know your blood glucose tends to drop during your activity.
7 -14 mmol/L	It should be fine to exercise.
Higher than 14 mmol/L	At this level there may not be enough insulin to use glucose. Check for ketones. If there are no ketones you could give a small correction dose and proceed to exercise. If ketones are present, give a full correction dose and postpone exercise until blood glucose levels have decreased.

For some sports, such as swimming or contact sports, you may need to take your insulin pump off. If your activity lasts longer than an hour you should check your blood glucose levels, and you may need to bolus insulin if your blood glucose levels have risen.

### During activity

For all types of activity, it is worth monitoring blood glucose levels frequently and aiming for a level of around 6-8 mmol/L. Keep well hydrated by drinking plenty of fluids, and have hypo treatment with you. It is a good idea to tell someone else when you intend to return if you are out exercising alone.

Specialist (expensive) sports drinks are not normally necessary unless you are undertaking endurance activities such as a marathon/triathlon or other competitive long lasting sport. If you are using these drinks be sure to check the carbohydrate content as there are different types available. Some drinks and snacks and their carbohydrate content are listed at the end of this leaflet.

How you manage your insulin and carbohydrate depends on the type and duration of the activity. Use the following table as a guide for adjusting insulin/carbohydrate intake. Mixed (biphasic) insulin should not be adjusted; you should eat or drink carbohydrate to prevent low blood glucose levels instead.

Continued on next page.

## Patient Information

Exercise	Example	Rapid acting insulin adjustment	Carbohydrate
Short term / gentle exercise (less than 30 mins)	Walking the dog	No adjustment	Have hypo treatment with you
Medium term / gentle exercise	Leisure swimming Supermarket or clothes shopping for more than an hour	No adjustment, or minimal (0-25%) reduction prior to exercise  <b>Insulin pump:</b> TBR 10-25% reduction starting up to 30 minutes prior to exercise	Additional 10-20g carbs per hour. Have hypo treatment with you
Prolonged / intense (up to 4 hours)	Jogging, football	30-50% reduction prior to exercise. 10-50% reduction following exercise.  <b>Insulin pump:</b> TBR 30-50% reduction starting 30-60 minutes prior to exercise	Additional carbs during exercise (30-60g per hour). Have hypo treatment with you
Prolonged exercise over 4 hours	Hiking, golf, endurance sports DIY e.g. painting, or stripping wallpaper	50% prior to and during exercise. 30-50% reduction following exercise. 10-20% reduction for up to 24 hours afterwards  <b>Insulin pump:</b> TBR 50% reduction starting 30-60 minutes prior to exercise, and possibly continued afterwards.	Additional carbs (30-60g per hour). Have hypo treatment with you. Extra carbs may also be needed post-exercise.

### After activity

You will have to monitor your blood glucose levels frequently in the hours after your activity in order to understand how your body responds to the type, duration and intensity of your chosen activity. For anaerobic intense exercise you may find your blood glucose levels are high afterwards; if it was prolonged aerobic activity your blood

## Patient Information

glucose is more likely to be low. Research suggests that a 10-second sprint at the end of moderate intensity exercise releases hormones that help to prevent hypoglycaemia.

Exercise increases insulin sensitivity within the body, and depletes glycogen stores in the muscles and liver which must be replenished in the hours afterwards. Both of these effects increase the likelihood of post-activity hypoglycaemia. You may need to have carbohydrate snacks and/or reduce your insulin doses in the 24 hours following exercise – you should eat rather than reduce your insulin dose if you are on mixed/biphasic insulin. It is also important to maintain hydration after activity.

**If you removed your insulin pump** for exercise, you may have to calculate and give the missed basal insulin as a bolus after you re-connect the pump. Try the following:

- A temporary basal increase to 150% for 30-60 minutes, or
- A 50% correction bolus to manage high blood glucose levels, or
- Bolus half of the missed basal at the end of the activity.

### Exercise snacks

Use the following table to plan your exercise snacks when needed.

Hypo treatments	Carbs
200 ml Lucozade Energy	18g
250 ml Lucozade Sport	16g
150 ml fruit juice	15g
165ml (half a can) non-diet cola	18g
9 jelly beans	15g
5 Fruit Pastilles	15g
4 jelly babies	15g
5 Dextro Energy tablets	15g
4 Gluco Tabs	16g

Slow-acting carbohydrate	Carbs
A small banana	15g
One medium slice toast	15g
Two finger chocolate wafer	13g
Small box raisins (14g)	11g
2 Digestive biscuits	18g
1 crumpet	17g
Half a pint of milk	14g
125g low fat yogurt	15g
1 Weetabix + 100ml milk	19g

**Be aware of variations in carbohydrate between different brands. Always double check the labels to be sure.**

### Useful resources

- <http://www.excarbs.com/>
- <http://www.runsweet.com/>
- Diabetic Athlete's Handbook, by Sheri R Colberg

## Patient Information

**Your Dietitian is:**

**Contact Number:**

### Further Information

This leaflet was produced by Coventry and Rugby Dietitians, University Hospitals Coventry & Warwickshire NHS Trust. If you have any other questions or would like further information, please contact the team on 024 7696 6161.

The Trust has access to interpreting and translation services. If you need this information in another language or format, please contact 024 7696 6161 and we will do our best to meet your needs.

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Contact Tel	Ext 26161
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