

# Diabetes and Sport

Getting the Balance Right



ES-AMC 11

# 1. Introduction

This leaflet is designed for people with diabetes who require insulin and wish to exercise.

## Why Exercise?

Exercise is good for everyone, not just for people with diabetes. It helps you feel good, look better, keeps you fit and can be fun!

Exercise can improve your:

- ◆ well being and self-esteem
- ◆ weight
- ◆ fitness
- ◆ muscle tone and the working of your heart and lungs
- ◆ blood glucose control
- ◆ social life

## What is exercise?

Exercise means different things to different people. For those involved in competitive sport it may mean many hours of training. For other people it may just mean going for a walk at the weekend, a swim or school/team activities.

## Before you start

The main areas you need to consider are:

- ◆ Your blood glucose level
- ◆ Your food
- ◆ Your insulin regimen

All areas require careful consideration when planning your training, to help you enjoy your sport and to be able to train, get fit and perform to the best of your ability.

## Exercise Diary

It may be useful to keep an exercise diary to record the following:

- ◆ When you exercise
- ◆ How long and how hard you exercise
- ◆ Carbohydrate intake before, during and after exercise
- ◆ Blood glucose levels before, during and after exercise
- ◆ Insulin doses

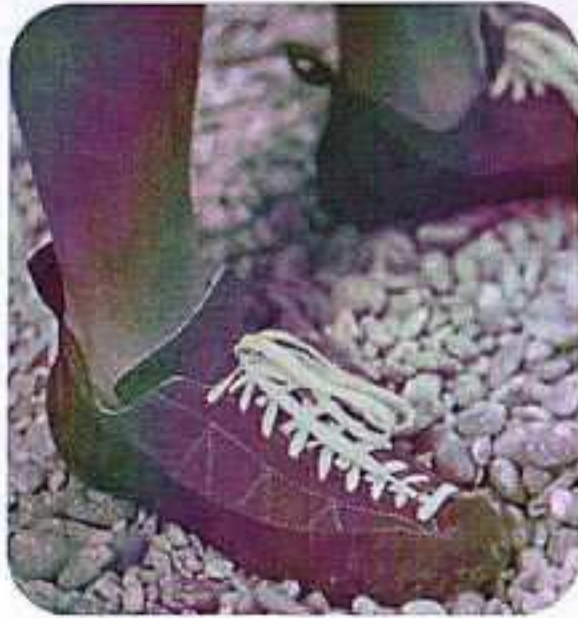
Everybody's diabetes is different and so you need to discuss your individual plan and have regular reviews with your diabetes team (dietitian, nurse, doctor).

Before beginning any physical activity programme you should talk to your doctor to check if the type of exercise is appropriate for you.



## Foot care

It is important to make sure your feet are in tiptop condition before you embark on any exercise however much this is. Make sure toenails are not long and there are no jagged edges that may cause injury. If you have any pain in your



feet or hard skin these problems need to be addressed by a Podiatrist, as there is a risk of causing injury to your feet whilst performing the exercise.

Always wear socks made from natural fibres (cotton or wool mixes) as these help to absorb any sweat and provide a protective layer

between your skin and the shoe.

Appropriate shoes for the exercise are important, for example stout supportive walking boots for walking any distance.

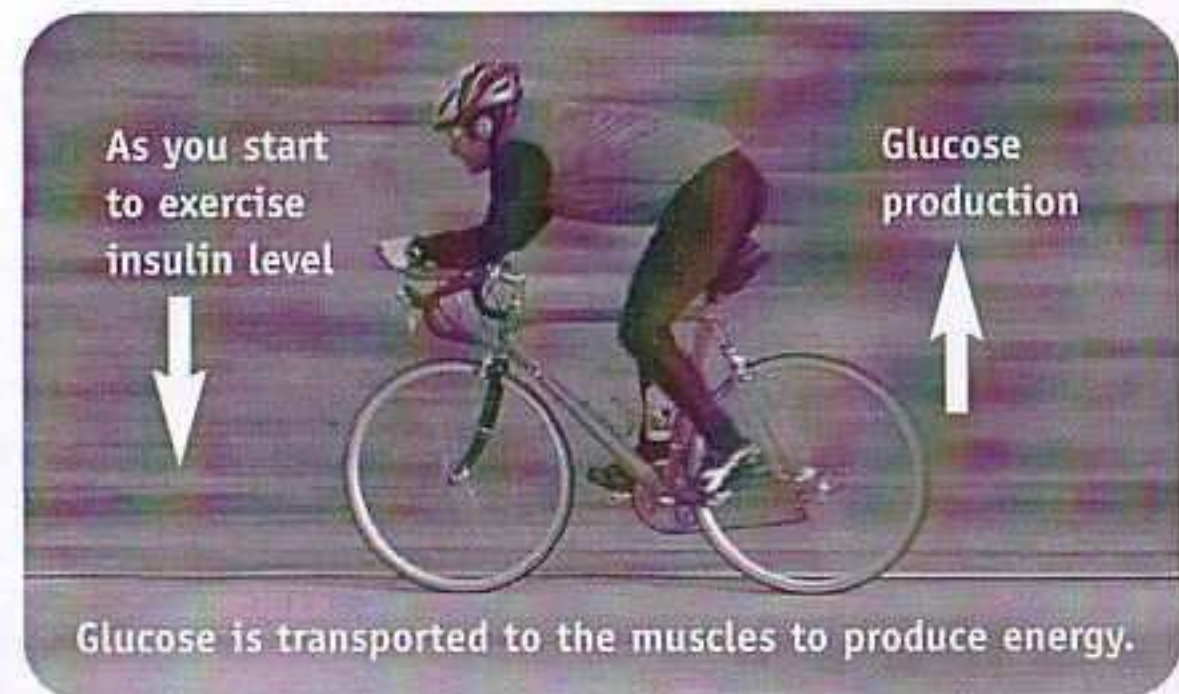
If you are considering purchasing trainers, make sure you buy a pair for the purpose you require, as there are many different variations for different sports e.g. running trainers will be different from racquet sports trainers.

## 2. Effect of Exercise on Blood Glucose Levels

How the body responds to exercise is different in the person with diabetes. Balancing your blood glucose level when you are exercising is very important, and can be a challenge.

### What happens during exercise in people who do not have diabetes?

- ◆ As you start exercise your insulin level falls which allows the liver to release glucose
- ◆ Some insulin is still needed to transport the glucose into the working muscles
- ◆ The glucose is then converted into energy in the cells
- ◆ This energy is used by your muscles so you can exercise effectively



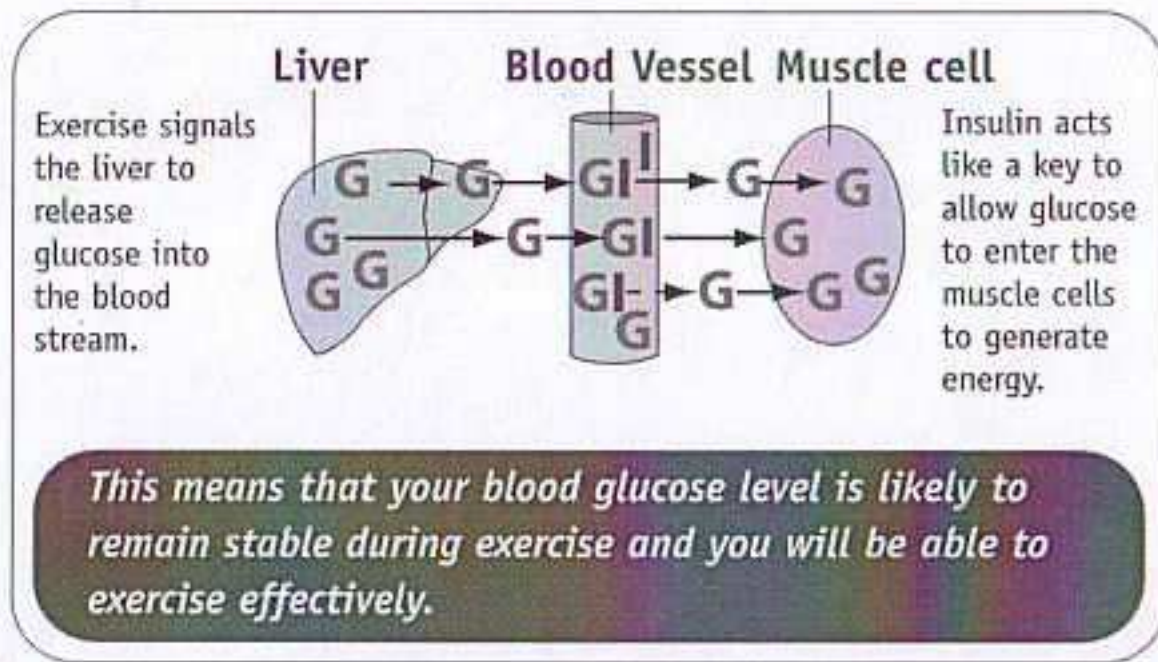
## So what happens during exercise in people with diabetes?

In people with diabetes this process may be different, depending on your pre-exercise blood glucose level and the amount of circulating insulin in your blood.

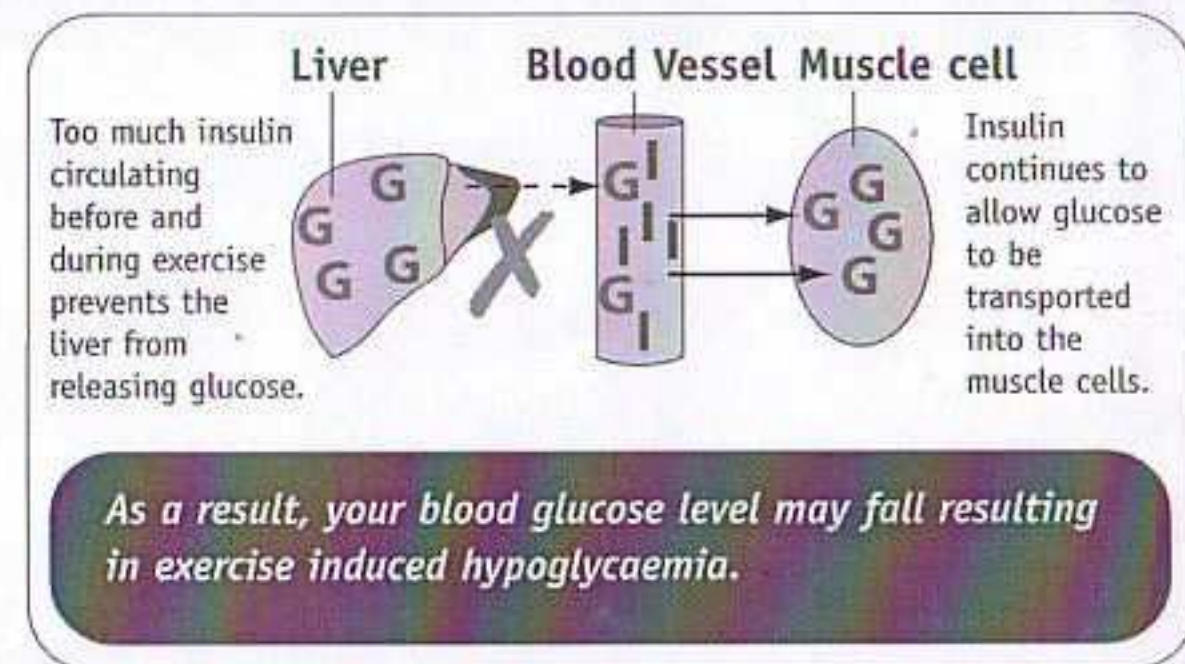
### 3. Effects of circulating insulin

The amount of insulin circulating in your blood before, during and after exercise is extremely important to allow you to exercise effectively. Training with either too much or too little circulating insulin will influence your blood glucose level and may make training harder.

The right amount of insulin circulating before exercise allows your liver to release the right amount of glucose for your muscles during exercise. Enough insulin is available to allow glucose to enter the muscle cells which can then be used for energy.



Too much insulin, circulating before and during exercise, prevents the liver from releasing glucose. As you exercise, your muscles will continue to take up glucose from the blood to generate energy. Increased glucose uptake by your muscles, combined with reduced glucose release from your liver may result in insufficient glucose being available to meet the extra energy demands during exercise.

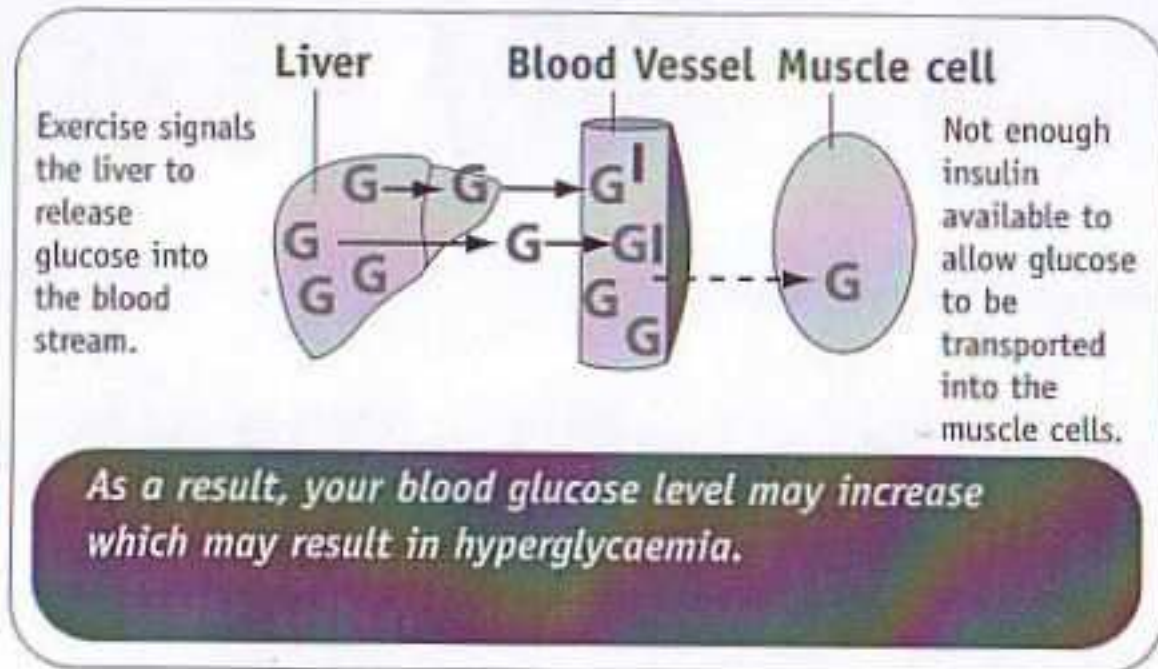


Key to the effects of circulating Insulin drawings:

**G** = Glucose

**I** = Insulin

**Too little insulin** circulating before exercise allows the liver to release glucose. During exercise the muscles require glucose to generate energy. If the level of insulin in your blood is too low, glucose cannot enter the muscle cells to provide the necessary energy.



Having the right amount of **insulin** means that your blood glucose level is more likely to remain stable during exercise and you will be able to exercise effectively.

## 4. Fuel for Exercise

Food consists of a mixture of nutrients. Energy is provided by protein, fat and carbohydrate. Fat, although a good source of energy, is digested (broken down) slowly. Protein is only used for energy in extreme sports. Carbohydrate is broken down quickly and is therefore the most important fuel for your muscles. Small amounts of carbohydrate are stored in your muscles and liver in the form of glycogen.



### Which fuels are used during exercise

Sports of high intensity or short duration e.g. sprinting, use mainly carbohydrate as the fuel source.

Sports of mixed intensities and duration e.g. football, rugby, netball, tennis and badminton also use mainly carbohydrate as the fuel source.



Endurance sports and sports of moderate intensity or long duration e.g. long distance running or hiking, use a mixture of carbohydrate and fat as the fuel source.

## How does food affect your blood glucose level?

Food consists of a mixture of nutrients. Protein, fat and carbohydrate provide energy in your diet. However, they do not all have the same effect on your blood glucose level.

### Digestion of food

#### 1. Protein

Meat  
Fish  
Eggs  
Cheese  
Nuts  
Soya



Amino Acids

Minimal effect on  
blood glucose level



#### 2. Fat

Butter  
Margarine  
Cream  
Oils



Fatty Acids

Minimal effect on  
blood glucose level



#### 3. Carbohydrate

Starchy Food  
Sugary Food



Glucose

Increase blood  
glucose level



## Carbohydrate: the fuel for exercise

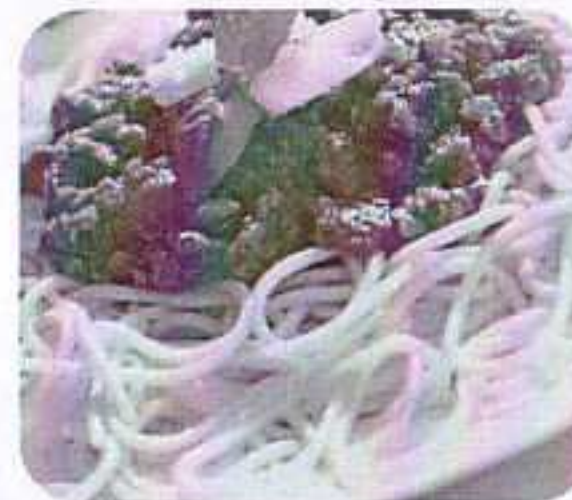
Carbohydrate is the most important fuel for your muscles and is essential in all types of exercise.

It is important that you are able to balance your carbohydrate intake and insulin dose to enable you to exercise safely and perform better.

### Which foods contain carbohydrate?

#### Main types of carbohydrate

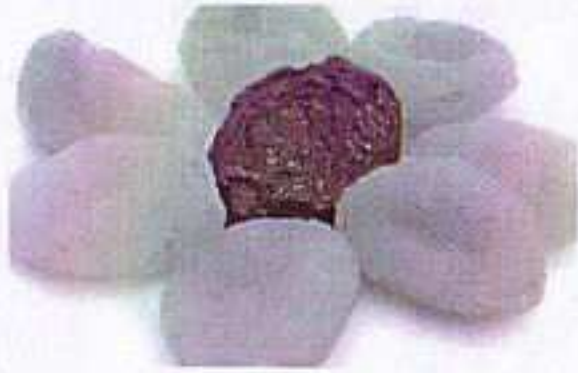
##### Starchy Carbohydrates



#### Dietary sources

Grains e.g. wheat, barley, rye and oats.  
Bread and flour products e.g. biscuits, cakes and pastry.  
Breakfast cereals.  
Pasta and noodles.  
Couscous.  
Rice.  
Potatoes and potato products.  
Pulses e.g. baked beans, red kidney beans, peas and lentils.

### Sugary carbohydrates



### Food and drink containing natural sugars

Fruit and fruit juices.  
Milk and milk products  
e.g. yoghurt, mousse, custard  
and ice cream.  
Honey.



### Food and drink containing added sugar

Sweets, chocolates, desserts,  
jams, marmalade and sugary  
drinks.

### Glycaemic Index

Carbohydrates can also be grouped according to the extent to which they raise blood glucose levels. This is called the glycaemic index.

Low glycaemic index carbohydrates are broken down more slowly, therefore releasing their glucose over a longer period of time.

High glycaemic index carbohydrates are broken down more quickly and therefore release their glucose over a shorter period of time.

### How do you know how much carbohydrate you need?

Carbohydrate (glycogen) stores are used up during exercise. Therefore extra carbohydrate may be needed before, during and/or after exercise.

**Q.** How do you know if you need extra carbohydrate?

**A.** Test your blood glucose level.



## 5. Blood Glucose Level

Your blood glucose level before exercise will indicate whether it is safe to exercise and how much carbohydrate you need.

Blood glucose level (mmol/l)	Ketones present?	Action	Carbohydrate needed
Less than 4	No	<b>Do not exercise.</b> Treat hypoglycaemia. Retest after 15 mins. If blood glucose above 4 mmol/l you can start exercising. It is then essential to have additional carbohydrate during exercise to prevent a further 'hypo'.	10-20g for every 30 mins of exercise (1-2 items from 'snack attack' list) <b>This is in addition to hypo remedy.</b>
4-7 (Ideal range)	No	<b>OK to Exercise.</b> Additional carbohydrate needed.	10-20g for every 30 mins of exercise (1-2 items from 'snack attack' list)
7-10	No	<b>OK to Exercise.</b> Consider extra carbohydrate depending on type and length of exercise.	10-20g for every 30 mins of exercise (1-2 items from 'snack attack' list).
11-17	No	<b>Exercise with caution.</b> Retest blood glucose level after 30 mins. If the level is decreasing, sufficient insulin is available and it is OK to continue. If the level is increasing there is not enough insulin and you should consider if it is safe to continue.	Nil
More than 14	Yes	<b>Do not exercise.</b> Risk of becoming unwell (Diabetic ketoacidosis).	Nil

## Snack Attack List

Each of the following snacks contains approximately 10-20g carbohydrate.



- 50-100ml Lucozade energy
- 100-200ml cola (not diet)
- 150-300ml lemonade (not diet)
- 100-200ml unsweetened fruit juice
- 200-300ml isotonic sport drink

Carbohydrate Gels e.g. 1 SIS Go Gel or, 1 High Five Isotonic Gel or, 1 tube of Hypofit or, 2 GlucoGel ampoules.



- 2-4 Standard jelly babies
- 4-8 Fruit Pastilles
- 3-6 Starbursts
- 4-8 Chewits
- 10-20 Dolly Mixtures
- 10 - 20 Skittles



- 1 tablespoon raisins/currants
- 3-6 dried apricots
- 1 medium banana
- 1 fruit bar e.g. school bar

NB: These values are approximate and it is important to check the food labels for exact carbohydrate content.

## Eating for Exercise

For exercise longer than one hour you may need to have extra carbohydrate in addition to the amounts suggested above. This will need to be discussed with your diabetes team.

Testing your blood glucose level during exercise will indicate your individual response to the activity, which will help you to manage your diabetes and improve your performance.

*As a guide, aim to have an additional 10-20g of carbohydrate for every 30 minutes of exercise.*

If you exercise in the afternoon or evening you are more likely to be at risk of nocturnal hypoglycaemia, especially if the exercise is strenuous. It is important to have a carbohydrate snack before bed and/or consider reducing your rapid acting insulin dose to reduce the risk.

## Meal Planning

It is important to consider the types of carbohydrate foods eaten before, during and after exercise.



### Pre-exercise carbohydrate meal

You should try to have some low glycaemic index carbohydrate foods 2 - 3 hours before exercise e.g.

- ◆ Low GI breakfast cereal e.g. porridge, bran flakes, Special K or muesli
- ◆ Granary or wholegrain bread
- ◆ Filled pitta bread
- ◆ Fruit loaf/muffin
- ◆ Pasta or pasta salad/ravioli
- ◆ Basmati rice and sauce
- ◆ Jacket potato with baked beans
- ◆ Baked beans on granary toast
- ◆ Oat based cereal bar
- ◆ Fresh Fruit e.g. apple and banana
- ◆ Yoghurt



### Pre exercise carbohydrate snack

You should try to have moderate to high glycaemic index carbohydrate foods immediately before exercise depending on your blood glucose level, e.g.

- ◆ Isotonic sports drink
- ◆ Diluted fruit juice
- ◆ Sweets e.g. jelly babies/Skittles
- ◆ Plain biscuits/Jaffa cakes
- ◆ Scotch pancakes



*N.B. Chocolate bars are not an ideal pre-exercise snack because they are high in fat. Fat slows down the absorption of carbohydrate.*

### Carbohydrate during exercise

The types of carbohydrate you choose will depend on the type of exercise you are doing, what you can tolerate and what is practical.

- ◆ Sports drinks and carbohydrate gels for water-based sports and high intensity sports e.g. sprinting, rugby and hockey games
- ◆ Food and drinks for less intense sports e.g. cycling, hiking, golf or in team events when there is a half time break. See snack attack list on page 16 for more ideas.

### Carbohydrate after exercise



After exercise your blood glucose level may continue to fall. This is because the carbohydrate (glycogen) stores in your liver and muscles need to be replenished as they have been used up during exercise. It is important to test your blood glucose level.

You should also try and have a high glycaemic index carbohydrate meal within 2 hours of finishing exercise with the appropriate amount of insulin.

After you have finished exercising you may be more sensitive to insulin and therefore at risk of hypoglycaemia for up to 24 hours. You may need to reduce your insulin dose as well as having additional carbohydrate. This is particularly important when you are exercising in the evening.



### Tournaments

There is often insufficient time to refuel properly between games, so it is important to monitor your blood glucose levels carefully. It may be necessary to have frequent high glycaemic index carbohydrate snacks or drinks during this time.

*Remember, you cannot train or compete effectively without sufficient fuel and insulin on board.*

### Drinks

Fluid is needed to prevent dehydration. Sweating keeps the body cool, preventing you from becoming overheated.

You normally require about 2-3 litres of fluid a day but during exercise an extra half to one litre (500ml to 1000ml) per hour is often needed. The amount

needed depends on a number of factors such as how hard you work, and environmental conditions such as humidity and/or temperature. The colour of your urine can indicate if you are hydrated and the "pee chart" can be discussed with your team. Don't wait until you feel thirsty before you drink as this indicates you are already becoming dehydrated.



### Suitable drinks to have before and during exercise:

- ◆ Water
- ◆ No added sugar squash
- ◆ Isotonic sports drinks (5-7g carbohydrate/100ml)
- ◆ Home made isotonic drinks (See next page)

*Isotonic sports drinks contain carbohydrate and should only be used if you need the extra fuel or you are exercising for a long time.*

### Recipes for D.I.Y. Isotonic sports drink

This is ideal for providing some carbohydrate during exercise and for replacing fluid lost.

60g sugar = (either 3 tablespoons or 12 sugar cubes)

1 litre of warm water

1-1.5g (pinch) salt

No added sugar squash for flavouring

or

675ml unsweetened orange juice

325 ml water

1-1.5g (pinch) salt

or

575ml unsweetened pineapple juice

425ml water

1-1.5g (pinch) salt

or

600ml unsweetened apple juice

400ml water

1-1.5g (pinch) salt

Homemade drinks may seem a good alternative and can be a good option from a cost point of view. However, it is extremely difficult to replicate a commercial sports drink accurately. It is advisable to use digital scales and an accurate measuring jug so that the composition of the drink is correctly formulated.



## 6. Pulling it all together

### What to put in your kit bag

- ◆ Sports kit!
- ◆ Insulin and blood glucose/ketone monitoring kit
- ◆ Hypo remedy
- ◆ Diabetes identification
- ◆ Drinks
- ◆ Snacks

### Before exercising, it's worth taking time to consider the following:

- ◆ Check your blood glucose level: Is it safe to exercise?
- ◆ Do you need carbohydrate before exercising?
- ◆ Do you need additional carbohydrate during exercise?
- ◆ Do you need to make any adjustments to your insulin?
- ◆ Hypo remedy available?



### During exercise

- ◆ Extra carbohydrate may be needed depending on how long you are exercising
- ◆ If practical, check your blood glucose level if exercise lasts longer than an hour
- ◆ Don't forget to drink to prevent yourself becoming dehydrated

## After exercise

- ◆ Rehydrate to replace the fluid you have lost from sweating
- ◆ Have a carbohydrate snack or meal high in carbohydrate
- ◆ Check your blood glucose levels at least 2 hours after exercise and before bed
- ◆ You may need to reduce your insulin dose and/or have extra carbohydrate to eat

## Improving diabetes control

To achieve good diabetes control during exercise, it will be useful for you to collect the following information.

- ◆ Blood glucose readings before, during and after exercise
- ◆ Insulin given
- ◆ Carbohydrate and fluid intake before, during and after exercise
- ◆ Type, duration and intensity of exercise completed
- ◆ Environmental conditions e.g. hot or cold
- ◆ Training or competition
- ◆ How fit you are!



With help from your diabetes team it may be possible for you to make further adjustments to improve your blood glucose control during exercise to enhance your performance.

*A hypo remedy must be available/accessible at all times during exercise. Tell somebody else where it is. Don't keep your glucose remedy in the locker in the changing room!*

## Suitable hypo remedies, each containing 10g of rapid acting carbohydrate

- ◆ 3 glucose tablets or 2 teaspoons sugar or 2 sugar lumps
- ◆ 50ml Lucozade Energy
- ◆ 1 tube of glucose gel e.g. GlucoGel, Hypofit, Lucozade gel
- ◆ 100ml cola (not diet or sugar free)
- ◆ 150ml lemonade (not diet or sugar free)
- ◆ 2 standard/ 3-4 mini jelly babies



## 7. Questions and Answers

**Q. Why does my blood glucose level go up after exercise?**

**A. This can be because;**

- ◆ You have too little insulin circulating
- ◆ You have eaten too much carbohydrate before or during exercise
- ◆ Exercise was very strenuous
- ◆ Competitive sport

**Q. Why does my blood glucose level go down during exercise?**

**A. This can be because;**

- ◆ You have too much insulin circulating
- ◆ You have not had enough carbohydrate before or during exercise
- ◆ Exercise is prolonged over 2-3 hours

**Q. Why does my blood glucose level stay the same?**

**A. This is because;**

- ◆ There is the right amount of insulin circulating
- ◆ You have had enough carbohydrate before or during exercise
- ◆ Exercise is of short duration and of low intensity
- ◆ You've read this leaflet!

**Q. What can I do if I can't eat just before exercise?**

**A. You can use;**

Drinks containing appropriate amounts of carbohydrate e.g. Isotonic sports drinks.

**Q. I'm watching my weight. What can I do as I don't want to eat too much extra food?**

**A. It is important that you;**

Eat sufficient carbohydrate to give you energy to exercise, but if you find you are eating to prevent hypos, you may need to modify your insulin regimen.

**Useful Telephone Numbers:**

Diabetes Specialist Dietitian:

Diabetes Specialist Nurse:

Consultant:

Podiatrist:

**Useful Websites:**

Dietitians in Sport and Exercise  
[www.disen.org](http://www.disen.org)

UK Sport  
[www.ukssport.gov.uk](http://www.ukssport.gov.uk)

Diabetes and exercise  
[www.runsweet.com](http://www.runsweet.com)

Diabetes UK  
[www.diabetes.org.uk](http://www.diabetes.org.uk)

**Further Reading:**

Hanas R. Type 1 Diabetes in children, adolescents and young adults. 3rd edition. (2007) Class Publishing, London UK. ISBN: 13 9781859591536.

Nagi D. (Ed) Exercise and Sport in Diabetes. 2nd edition. (2005). Wiley, UK. ISBN: 13 978-0-470-02206-X.



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