

# CARBOHYDRATE LOADING

Anyone interested in sport is likely to have heard of the term 'carbohydrate loading'. However it is probably one of the most misunderstood terms in sports nutrition. People commonly think anyone involved in sports needs to 'carb up' and the way to do this is to eat 'flat out' in the days leading up to an event. Read on to get the facts on carbohydrate loading.

## ***What is carbohydrate loading?***

Carbohydrate loading is a strategy involving changes to training and nutrition that can maximise muscle glycogen (carbohydrate) stores prior to endurance competition. The technique was originally developed in the late 1960s and typically involved a 3-4 day 'depletion phase' and a 3-4 day 'loading phase'. Ongoing research has allowed the method to be refined so that modern day carbohydrate loading is now more manageable for athletes.

## ***Does carbohydrate loading improve performance?***

Muscle glycogen levels are normally in the range of 100-120 mmol/kg ww (wet weight). Carbohydrate loading enables muscle glycogen levels to be increased to around 150-200 mmol/kg ww. This extra supply of carbohydrate has been demonstrated to improve endurance exercise by allowing athletes to exercise at their optimal pace for a longer time. It is estimated that carbohydrate loading can improve performance over a set distance by 2-3%.

## ***Who should carbohydrate load?***

Anyone exercising continuously for 90 minutes or longer is likely to benefit from carbohydrate loading. Typically, sports such as cycling, marathon running, longer distance triathlon, cross-country skiing and endurance swimming benefit from carbohydrate loading. Shorter term exercise is unlikely to benefit as the body's usual carbohydrate stores are adequate. Carbohydrate loading is generally not practical to achieve in team sports where games are played every 3-4 days. Although it might be argued that players in soccer and AFL have heavy demands on their muscle fuel stores, it would be impossible to achieve a full carbohydrate protocol within the weekly schedule of training and games.

## ***How was carbohydrate loading originally achieved?***

Originally, carbohydrate loading involved a depletion phase. This required 3-4 hard training days plus a low carbohydrate diet. The depletion phase was thought to be necessary to stimulate the enzyme glycogen synthase. The depletion phase was followed by a loading phase which involved 3-4 days of rest combined with a high carbohydrate diet. The extra carbohydrates combined with the now-activated glycogen synthase was shown to boost carbohydrate stores beyond their usual resting levels.

## ***How do modern-day athletes carbohydrate load?***

Today's endurance athletes use a modified carbohydrate loading method. Ongoing research has demonstrated that the depletion phase is no longer necessary. This is a bonus for athletes as the depletion phase was very difficult. Australian marathon runner Steve Moneghetti has described the depletion phase as making him feel like "death warmed up". Today, 3-4 days of exercise taper while following a high carbohydrate diet (7-10 g/kg body weight) is sufficient to elevate muscle glycogen levels.

### **What does a high carbohydrate diet look like?**

The following diet is suitable for a 70 kg athlete aiming to carbohydrate load:

Breakfast	3 cups of low-fibre breakfast cereal with 1 ½ cups of reduced fat milk 1 medium banana 250 ml orange juice
Snack	Toasted muffin with honey 500 ml sports drink
Lunch	2 sandwiches (4 slices of bread) with filling as desired 200 g tub of low-fat fruit yoghurt 375 ml can of soft drink
Snack	Banana smoothie made with low-fat milk, banana and honey Cereal bar
Dinner	1 cup of pasta sauce with 2 cups of cooked pasta 3 slices of garlic bread 2 glasses of cordial
Late Snack	Toasted muffin and jam 500 ml sports drink

This sample carbohydrate loading meal plan provides roughly 14,200 kJ, 590 grams of carbohydrate, 125 grams of protein and 60 grams of fat.

### **Are there any special considerations for females?**

Most studies of glycogen storage have been conducted on male athletes. However, some studies suggest that females may be less responsive to carbohydrate loading, especially during the follicular phase of the menstrual cycle. Further research needs to be conducted specifically on females.

What are the common mistakes made when carbohydrate loading?

Research indicated that many athletes who attempt to carbohydrate load fail to achieve their goal. The method sounds simple, so what are so many athletes doing wrong? The most common mistakes are outlined below:

- Carbohydrate loading requires an exercise taper. Athletes can find it difficult to back off and not train hard for 3-4 days before competition. Failing to rest will compromise carbohydrate loading.
- Many athletes fail to eat enough carbohydrate. It sounds easy to increase your carbohydrate intake but many athletes fall short of the mark. It seems athletes don't have a good understanding of the amount of food required to carbohydrate load. Working with a sports dietician or using a carbohydrate counter can be useful.
- In order to consume the necessary amount of carbohydrate, it is necessary to cut back on fibre and make use of compact sources of carbohydrate, such as sugar, cordial, soft drink, sports drink, jam, honey, jelly and tinned fruit. Athletes who include too many high fibre foods in their carbohydrate loading menu may suffer stomach upset or find the food too bulky to consume.

- Carbohydrate loading will most likely cause body mass to increase by approximately 2 kg. This extra weight is due to extra muscle glycogen and water. For some athletes, the fear of weight gain may prevent them from carbohydrate loading adequately.
- Athletes commonly use carbohydrate loading as an excuse to eat everything and anything in sight. Consuming too many high fat foods will make it difficult to consume sufficient carbohydrate. It may also result in gain of body fat. It is important to stick to high-carbohydrate, low-fat foods while carbohydrate loading.

Is carbohydrate loading always going to be beneficial? List some examples of when it may be inappropriate.

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**Tapering** means gradually reducing training before an event to allow the body to recover from stress – it is often done in conjunction with carbohydrate loading.

A trial was conducted back in the 1980's by a group of Canadian researchers at the McMaster University in Ontario. The trial was conducted for a one week period, with a group of experienced endurance athletes who all run approximately 50 miles a week in training. The athletes were split into 3 groups, with each group working a different training programme for the week. At the end of the week the performance improvement for each group was checked. The results were as follows:

Group	Training programme	% reduction in training load	% improvement
1	No training	100%	0%
2	1.8 miles (easy running)	64%	6%
3	6 miles (500m sessions at max effort)	88%	22%

As it can be seen from the table, group 3 achieved the best improvement in their performance (22%). In addition, group 3 enjoyed four advantages over the other groups:

- More glycogen in the leg muscles
- Increased density of red blood cells
- Increased blood plasma
- Increased enzyme activity in their leg muscles