TYPE 2 DIABETES
AND THE LOW CARBOHYDRATE DIET

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This leaflet provides a basic overview of type 2 diabetes and information on a low carbohydrate approach for managing type 2 diabetes and potentially placing it into remission. Remission of type 2 diabetes means a normal blood sugar level without needing medication.

Many people find that choosing a low carbohydrate diet means having an enjoyable lifestyle today, while also achieving hope for a healthier future.

WHAT IS TYPE 2 DIABETES?

Type 2 diabetes is a condition of high blood sugar. The sugar in the blood is called glucose. There are about 5 litres of blood in the adult body, and a normal blood glucose is just 4 or 5 grams, or 1 teaspoon, in all of the blood.

How does glucose get into our blood?

Glucose in our blood comes directly from the food we eat, and it is also released from our liver.

- Glucose released by our liver comes from glucose stores, known as glycogen. The liver can also make glucose.
- Foods that deliver glucose to our blood are those that contain sugar, and also starchy foods that digest down into sugar such as bread, potatoes or rice. Sugar and starch are known as carbohydrates.

How does the body usually keep the blood glucose level normal?

To try to keep our blood glucose level normal our body uses a hormone called insulin. Insulin is made and released from an organ in the abdomen called the pancreas. When our blood glucose level rises, for example after eating sugary or starchy foods, insulin is released. Insulin reduces blood glucose by pushing it into muscle cells for energy, and also into fat and liver cells where the excess sugar is turned into more fat. Insulin also tells the liver to stop making glucose until the blood glucose level drops to normal.

Why does high blood glucose happen in type 2 diabetes?

High blood glucose happens when the insulin system is not working properly, and when we eat too much sugar and starch the glucose isn't pushed out of the blood efficiently. Also in type 2 diabetes the liver makes and releases too much glucose as it is not receiving the 'stop' signal from insulin.

The insulin system 'not working properly' can be due to a number of reasons. One reason is the cells of the body can become resistant to the effect of insulin, and as a consequence more insulin is needed than normal. Obesity, particularly if some of the fat is in the pancreas or liver contributes to this, so weight loss can help. (Another cause for the 'insulin system not working properly' is due to failure of the pancreas gland to produce any insulin. This causes quite a different form of diabetes; known as 'insulin dependent' or type 1 diabetes.)

What problems can type 2 diabetes cause?

Adopting a healthier lifestyle can achieve significant improvements in type 2 diabetes. However if type 2 diabetes is ignored and an unhelpful lifestyle is followed there is higher risk of health problems including:

- Heart disease and stroke
- Kidney problems
- Eye problems, including loss of vision
- Blood vessel problems in legs, which can lead to amputation
- Nerve damage causing loss of feeling in limbs, and digestive problems
- In men it can also lead to impotence

> **Adopting a healthier lifestyle can achieve significant improvements in type 2 diabetes.**

HOPE FOR TYPE 2 DIABETES: REMISSION

For the last few decades type 2 diabetes has been incorrectly labelled as a progressive disease. This means we thought it was a condition that would only get worse over time. We now know this does not need to be true.

It is possible to make significant improvements to type 2 diabetes. This includes placing type 2 diabetes into remission, which means a normal blood glucose without needing medication. Other people find they may not reach remission of their type 2 diabetes but they do significantly improve their health and achieve a lower blood glucose, correct their weight, and need less medication.

Even people that have had type 2 diabetes for many years are finding with the right lifestyle choices they are able to improve their blood sugar and come off some or all of their medication.

How can type 2 diabetes be improved and placed into remission?

There are two dietary options that have been shown to significantly improve type 2 diabetes. These are:

- A low carbohydrate diet: reducing the amount of carbohydrate eaten to less than about 130g per day.
- A very low calorie diet: eating no more than 800kcal of food a day for a period of a few months.

A LOW CARBOHYDRATE DIET: WHAT DOES THIS MEAN?

Opting for a low carbohydrate diet means choosing to reduce the amount of glucose eaten. This is achieved by reducing dietary carbohydrates to less than about 130g a day because they either:

- Contain glucose, or
- Digest down into glucose (starchy foods like cereals, potatoes or bread do this). There are some relatively simple food choices that can help people adjust to this lifestyle (see separate resource 'What to Eat on a Low Carb Diet').

Personal needs and preferences can determine how low to go on a low carbohydrate diet. Some people may find eating up to 130g of carbohydrate a day works for them. Other people may need or wish to reduce their carbohydrate intake to a lower level, down to 50g a day or sometimes less.

MAKING A CHOICE

With any diet it is important for it to be achievable, sustainable and hopefully enjoyable. It also needs to be appropriate for a person's specific health needs as well as their culture and finances.

There are a small number of people who may not suit a low carbohydrate diet. Also medication adjustment may be needed before making a significant lifestyle change. It is therefore important for people with type 2 diabetes to discuss their lifestyle plans with their doctor and healthcare professional team.

With the right knowledge and support people can achieve significant health benefits, and make lasting improvements, not only to type 2 diabetes but also to weight, blood pressure, and wellbeing.

FURTHER RESOURCES

In combination with this information leaflet the following further resources are available by registering at www.lowcarbprogram.com, or by downloading the app:

- What to eat on a low carb diet
- Common side effects with a low carb diet

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WHAT TO EAT ON A LOW CARB DIET MADE SIMPLE:

A PRACTICAL GUIDE AND FOOD LISTS

This leaflet contains basic guidance and food lists designed to help make your food choices and food shopping easy.

A healthy low carb diet means eating natural, whole, unprocessed, foods. When on a low carb diet you may find you are less hungry at times, if this is the case then you can trust your instincts and eat when you are hungry.

A Basic Guide to Carbohydrate, Fat and Protein

Energy in our food comes from carbohydrate, fat and protein. These are known as macronutrients. A low carb diet is low in carbohydrate, has a higher amount of fat, and a normal amount of protein.

- **Carbohydrate:** A low carb diet means eating less than 130g of carbohydrate per day. Some people like to keep a track of the number of grams of carbohydrate they are eating. Other people prefer to simply focus on eating low carbohydrate foods (see the green list in this leaflet).
- **Fat:** On a low carb diet you can enjoy healthy natural fats, which includes oils, in your diet. This means it is fine to eat foods that naturally contain fat. Often it is fine to trust your appetite to decide whether to eat more or less fat. For energy the body can use fat that is eaten and also fat from our body stores. You can increase and decrease the amount of fat you eat depending on whether or not you want to lose weight. If you do not want to lose weight then eating plenty of fat will mean your body will not need to use its own fat stores.
- **Protein:** Simply eat a normal amount of protein foods. If you like to track your protein intake then aim for between 0.8g and 2g of protein per kilogram of your ideal body weight. For example, if your perfect body weight is 70kg then you should aim for between 60g and 140g of protein a day.

What to eat; the basics

- Avoid processed food
- Avoid sugar and refined carbohydrates such as biscuits, cakes, and bread
- Enjoy non-starchy vegetables (this includes green vegetables and most vegetables that grow above ground). A moderate intake of root vegetables is fine
- Enjoy fish/meat/dairy/eggs/nuts (legumes/pulses are good options for vegetarians and vegans)
- Enjoy healthy fats (for example olive oil), and natural fatty foods

Food Lists

The Food Lists below give lots of examples of actual foods and are divided into 3 groups. Next to each food is the amount of carbohydrate it contains, per 100g.

The **Green** Group you can enjoy and should make up the majority of your diet.

The **Amber** Group should be enjoyed in moderation.

The **Red** Group should be kept to small amounts or simply avoided.

PLEASE NOTE:

- All nutritional information is based on UK food databases.
- Nutritional information for total carbohydrate does not include fibre.
- Nutritional information can vary depending on brand, use of organic produce and seasonal variation. They should therefore should be used as an estimate only.
- Certain foods in the lists have been upgraded or downgraded in category because of characteristics other than their carbohydrate amount. For example, there are some higher carbohydrate foods placed in the green or amber categories due to their nutrient density, healthy fat content, lower glycaemic index (GI) and/or the fact they are natural, whole foods. Certain lower carbohydrate foods have been downgraded in category because they are processed, they are higher GI (e.g. custard), or they are at risk of oxidising (e.g. refined oils).

GREEN FOODS: THESE SHOULD MAKE UP THE MAJORITY OF YOUR DIET

VEGETABLES

Baby Spinach	0.2g/100g
Mushrooms	0.3g/100g
Celery	0.9g/100g
Cucumber	1.2g/100g
Chinese Cabbage	1.4g/100g
Lettuce	1.4g/100g
Kale	1.4g/100g
Spinach	1.6g/100g
Courgette	1.8g/100g
Radish	1.9g/100g
Asparagus	2g/100g
Pak Choi	2.2g/100g
Aubergine	2.2g/100g
Celeriac	2.3g/100g
Green Peppers	2.6g/100g
Leeks	2.9g/100g
Spring Onions	3g/100g
Green Beans	3.1g/100g
Broccoli	3.2g/100g
Shallots	3.3g/100g
Red Cabbage	3.7g/100g
Brussels Sprouts	4.1g/100g
Mangetout	4.1g/100g
Green Cabbage	4.1g/100g
Red Peppers	4.3g/100g
Cauliflower	4.4g/100g
Yellow Peppers	4.6g/100g
Sugar Snaps	4.8g/100g
White Cabbage	4.8g/100g
Turnip	5g/100g

FRUIT

Olives	Trace/100g
Rhubarb	0.8g/100g
Avocado	1.9g/100g
Tomatoes	3g/100g
Cranberries	3.4g/100g
Coconut	3.7g/100g
Honeydew Melon	4g/100g
Raspberries	4.6g/100g

MEAT, FISH & EGGS

Chicken	0g/100g
Beef	0g/100g
Lamb	0g/100g
Pork	0g/100g
Oily Fish e.g. salmon, mackerel, sardines	0g/100g
Eggs	Trace/100g

DAIRY

Hard Cheese e.g. cheddar	0.1g/100g
Cream e.g. double cream	1.7g/100ml
Crème Fraîche	2.4g/100g
Full Fat Greek Yoghurt	3g/100g
Sour Cream	3.6g/100g
Soft Cheese e.g. mascarpone	4.3g/100g
Whole Milk	4.6g/100ml

FATS

Olive Oil	0g/100g
Coconut Oil	0g/100g
Lard	0g/100g
Ghee	Trace/100g
Butter	0.6g/100g

NUTS

Brazil Nuts	3.1g/100g
Walnuts	3.3g/100g
Pine Nuts	4g/100g
Macadamia Nuts	4.8g/100g
Pecan Nuts	5.8g/100g
Hazelnuts	6g/100g
Almonds	6.9g/100g
Pistachios	8.2g/100g

SEEDS

Sesame Seeds	0.9g/100g
Flaxseed	1.6g/100g
Chia Seeds	7.3g/100g
Pumpkin Seeds	15.2g/100g
Sunflower Seeds	18.6g/100g

CUPBOARD ITEMS

Tinned Fish, in olive oil e.g. sardines	0g/100g
Herbs & Spices e.g. dried rosemary	1g/tsp
Coconut Cream	2.9g/100g
Tinned Tomatoes	3g/100g
Coconut Milk	3.3g/100ml

DRINKS

Water, still or sparkling	0g/100ml
Breakfast Tea, black	0g/100ml
Earl Grey Tea, black	0g/100ml
Herbal Tea, e.g. green tea or peppermint	0g/100ml
Coffee, black	0g/100ml

AMBER FOODS: THESE FOODS CAN BE ENJOYED IN MODERATION

VEGETABLES

Orange Peppers	5.3g/100g
Pimento Peppers	6.4g/100g
Beetroot	7.6g/100g
Carrots	7.7g/100g
Onions	8g/100g
Sweetcorn	8.1g/100g
Butternut Squash	8.3g/100g
Peas	11.3g/100g
Parsnips	12.5g/100g

FRUIT

Strawberries	6.1g/100g
Grapefruit	6.8g/100g
Watermelon	7.1g/100g
Peach	7.6g/100g
Orange	8.2g/100g
Plum	8.8g/100g
Nectarine	9g/100g
Blueberries	9.1g/100g
Kiwi	9.1g/100g
Figs	9.5g/100g
Pineapple	10.1g/100g
Pear	10.9g/100g
Cherries	11.5g/100g
Apples	11.6g/100g
Pomegranate Seeds	11.8g/100g

PROCESSED MEAT

Bacon	0g/100g
Cured meat e.g. Salami	0.05g/100g
Corned beef	0.5g/100g
Sausages (97% pork)	1.5g/100g
Spam	3.2g/100g
Processed Ham e.g. Bernard Matthews Wafer Thin Ham	3.7g/100g

NUTS

Peanuts	12.5g/100g
Cashews	18.1g/100g

CUPBOARD ITEMS

Mayonnaise	1.3g/100g
Natural/Whole Nut Butters e.g. Meridian peanut butter	11.6g/100g
Tomato Puree	12.9g/100g
Tinned Beans e.g. butterbeans	13g/100g
Tinned Pulses e.g. lentils	16.9g/100g
Dried Pulses e.g. lentils	48.8g/100g
Dried Beans e.g. butterbeans	52.9g/100g
Quinoa, dry	55.7g/100g

DRINKS

Pure Spirits e.g. vodka & gin	0g/100ml
Sugar Free Fizzy Drinks	0g/100ml
Red Wine e.g. Malbec	0.25g/100ml
Dry White Wine e.g. New Zealand Sauvignon	0.3g/100ml
Extra Dry Prosecco	1.2g/100ml

RED FOODS: THESE ARE FOODS THAT ARE BEST KEPT TO A MINIMUM OR AVOIDED

LOW FAT DAIRY

Low Fat Cheese e.g. low fat cheddar	0.8g/100g
Semi-skimmed Milk	4.7g/100g
Skimmed Milk	4.8g/100g
Low Fat Yoghurt e.g. Muller Light strawberry	7.8g/100g

VEGETABLES

Potatoes	19.6g/100g
Sweet Potatoes	21.3g/100g
Cassava	36.8g/100g

FRUIT

Mango	14.1g/100g
Grapes, green	15.2g/100g
Grapes, red	17g/100g
Banana	20.3g/100g
Dried Fruit e.g. apricot	43.4g/100g

REFINED OILS (Vegetable/Seed Oils)

Sunflower Oil	0g/100g
Rapeseed Oil	0g/100g
Corn Oil	0g/100g
Soybean Oil	0g/100g
Frylight Spray e.g. coconut, butter, sunflower, olive oil spray	0g/100g
Margarine	1.2g/100g

STARCHY / PROCESSED FOODS

Custard	15g/100g
Rice Pudding	15.8g/100g
Sausages (42% pork) e.g. Richmond	16g/100g
Breaded Meat & Fish e.g. breaded cod fillet	21g/100g
Pizza e.g. frozen pepperoni pizza	26.7g/100g
Ice Cream e.g. Ben & Jerry's cookie dough ice cream	30g/100g
Pancakes	33.9g/100g
Wholemeal Bread	36.7g/100g
Pastries e.g. croissant	43.8g/100g
White Bread	46.4g/100g
Popcorn e.g. salted popcorn	48.3g/100g
Jam Doughnut	48.4g/100g
Crisps e.g. Walker Crisps	51.5g/100g
White Chocolate	53.1g/100g
Cakes e.g. victoria sandwich	55.1g/100g
Milk Chocolate	57g/100g
Breakfast Bars e.g. Alpen light bar	59g/100g
Biscuits e.g. digestive	62.9g/100g
Oats	63.5g/100g
Crackers e.g. Ritz Cracker	63.5g/100g
Croutons	64.9g/100g
Noodles, dry weight e.g. egg noodles	72g/100g
Pasta, dry weight	75.6g/100g
Breadcrumbs	76.1g/100g
Brown Rice, dry weight	77g/100g
Rice Cakes	79.2g/100g
Cereal e.g. cornflakes	84g/100g
Fast Food e.g. Big Mac & medium fries	85g/100g
White Rice, dry weight	85.1g/100g

SAUCES & CONDIMENTS

Pasta Sauce e.g. bolognese	6.6g/100g
Curry Sauce	7.3g/100g
Nut Butters with added sugar e.g. Sunpat	14.7g/100g
Salad Cream	18.5g/100g
Relish	21.1g/100g
Tomato Ketchup	23.2g/100g
Salad Dressing e.g. balsamic vinegar	24g/100g
Brown Sauce	28.3g/100g
Barbeque Sauce	32g/100g
Chutney	32.7g/100g
Sweet Chilli Sauce	43.6g/100g
Chocolate Spread	57.6g/100g
Jam	69g/100g
Marmalade	69.5g/100g
Honey	81.5g/100g

DRINKS

Original Cider e.g. Strongbow	1.7g/100ml
Beer e.g. Budweiser	3g/100ml
Fruit Cider e.g. Strongbow Dark Fruit	4.2g/100ml
Fruit Juice e.g. Tropicana orange juice	8.9g/100ml
Milkshakes e.g. strawberry Yazoo	9.6g/100ml
Full Sugar Fizzy Drinks e.g. Coca Cola	10.6g/100ml
Energy Drinks e.g. Red Bull	11g/100ml
Cocktails e.g. strawberry daiquiri	11.2g/100ml
Smoothies e.g. Naked green smoothie	12g/100ml

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POSSIBLE SIDE EFFECTS AND SOLUTIONS:

A leaflet for patients and their healthcare professionals

Any significant change in diet carries the potential to cause side effects, often in the first 1-2 weeks. Everyone's body and situation are different, and many people have no issues when moving to a low carbohydrate diet. However knowing what side effects are possible can be reassuring, as well as knowing what solutions may help. Also knowing what is unexpected can help decide if further assessment is needed. If someone feels unwell or concerned about their symptoms then professional healthcare assessment should be sought. There can be other reasons, unrelated to the new low carbohydrate diet, for the symptoms listed below.

FEELING LIGHT HEADED OR DIZZY

This is usually due to low sodium (salt) level in the blood. This can happen because of a drop in the amount of insulin in the blood. When someone is eating a higher carbohydrate diet their insulin level can be higher. One action of insulin is to instruct the kidneys to keep sodium in the blood. The kidneys adapt to whatever the usual insulin level is to ensure the sodium level in the blood remains normal. When someone moves to a low carbohydrate diet there can be a sudden, expected, drop in insulin. It can take the kidneys 1-2 weeks to adapt to the lower insulin level, and until adaptation has occurred there can be excessive sodium and water lost in the urine.

Possible solutions:

- Have some extra salt on food during the first 1-2 weeks
- Drink adequate water
- Check blood pressure, and review blood pressure medications (particularly those which cause sodium loss from the kidneys)

MUSCLE CRAMPS

Some people experience muscle cramps, for example in the legs, with a low carbohydrate diet. There are two known possible causes for this. The first could be a low sodium level. The second reason could be a low magnesium level.

There is some evidence that many of the population have a low magnesium level (this is thought to be due to how our food is produced), and also that a low carbohydrate diet may exacerbate this problem.

Possible solutions:

- Ensure adequate salt and water intake
- Take an over-the-counter standard dose magnesium oral supplement. Some magnesium supplements can cause bowel upset and diarrhoea. Magnesium citrate or magnesium chloride are thought to be better tolerated, and carry less chance of causing bowel side effects.
- A bath with Epsom salts (which is magnesium sulphate) might help, although it is debated how much magnesium is absorbed through the skin.

CHANGE IN BOWEL MOVEMENTS (e.g. constipation)

Any dietary change can cause an initial change in bowel habit. This is thought to be at least partly due to the gut, including gut bacteria, requiring time to adapt to the new diet. Constipation is the most commonly reported bowel symptom, though loose stools and diarrhoea for a few days are also possible. The bowels usually adapt to the new diet within a couple of weeks. If constipation is a problem there are a number of options that may help.

Note: an altering bowel habit that persists for more than 2-3 weeks may not be due to the change in diet, and thus healthcare professional attention should be sought.

Also, a change in diet should not cause problematic abdominal pain.

Possible solutions to constipation:

- Ensure adequate water intake
- Magnesium supplementation may help (as described in the 'muscle cramps' section)
- Fibre may help, though this varies. Some people report benefit from increased fibre, whilst others report it can increase constipation. Increased fibre intake can be achieved through a greater consumption of vegetables.

SUGAR CRAVINGS

Cutting most carbohydrates, particularly sugars, out of the diet can be a big change for both the brain and body. Sugar is thought to affect the brain's reward and mood system. Giving up sugar can create withdrawal symptoms, which for some people can initially be quite challenging. Fortunately many people report these cravings reduce significantly over the first couple of weeks, although it can for some people take months. Tastes will often change with time, and often less sweet foods will become more enjoyable.

Possible solutions:

- Understanding why the dietary change is important can help to combat cravings.
- Many people find removing all sugar from their diet is the best option. This is because of the addictive nature of sugar, and the difficulty in keeping sugar to just small amounts.
- Some people find sweeteners a helpful transition step off sugar, whilst others find sweeteners cause the sweet taste and sugar cravings to persist.

MEDICATION

It is important to review prescribed medications with an appropriate healthcare professional before moving to a low carbohydrate diet. Diabetes medications and blood pressure medications are common examples that may need to be reviewed. Some diabetes medications will cause blood glucose to go too low (hypoglycaemia) when carbohydrate in the diet is reduced, and this can be harmful.

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