Diabetes and exercise *fact sheet*

» What is diabetes?

Diabetes mellitus (commonly referred to as "diabetes") is a chronic medical condition where there is excessive glucose in the bloodstream due to the bodies inability to adequately produce or properly use insulin.

» Incidence of diabetes in Australia

Approximately one million people in Australia are reported to have diabetes. In Australia, diabetes is the 6th leading cause of death. The cost directly associated with diabetes has been estimated to be $812 million in 2000-2001. Given the alarming increase in the incidence of diabetes in recent years these estimates of the number of people with diabetes and the costs are likely to be much greater.

» Diagnosis of diabetes

Diabetes is diagnosed by either two consecutive elevated fasting plasma glucose readings or via a glucose tolerance test. The oral glucose tolerance test is considered the gold standard test for Type 2 diabetes and is advantageous as it can diagnose impaired fasting glucose, impaired glucose tolerance, and Type 2 diabetes.

» How do I know if I have diabetes?

* Complete the "Australian Type 2 Diabetes Risk Assessment Tool" (available online at sma.org.au) which will assess your risk of developing Type 2 diabetes. These results can then be taken to your doctor for discussion. If your AUSDRISK score is "intermediate" or "high" your doctor may request that you complete a fasting plasma glucose test.

* If your fasting plasma glucose result is elevated OR if your AUSDRISK score is high, your doctor may request you complete an oral glucose tolerance test.

Pathology tests

1. Symptoms of diabetes and a casual (non-fasting) plasma glucose ≥11.1mmol/l (200 mg/dl). A casual (non-fasting) plasma glucose is defined as any time of day without regard to time since last meal. The classic symptoms of hyperglycemia include polyuria (frequent urination), nocturia (frequent urination at night), polydipsia (excessive thirst), polyphagia (excessive hunger) or unexplained weight loss. *

OR

2. Fasting plasma glucose ≥ 7.0mm/l (126mg/dl). Fasting defined as no caloric intake for at least 8 hours.*

OR

3. Two hour plasma glucose ≥11.1mmol/l (200 mg/dl) during an OGTT. The test should be performed as described by the World Health Organisation, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water.

*In the absence of unequivocal hyperglycemia, these criteria should be confirmed by repeat testing on a different day and must be established using a laboratory plasma glucose measurement on a separate day in asymptomatic individuals.

» Types of diabetes

There are several types of diabetes; Type 1, Type 2, and Gestational diabetes mellitus. Further, as diabetes is pandemic in Australia, there is now a category which is referred to as "Pre-diabetes". This is to identify individuals whose blood sugar levels are above normal however, not high enough to be classified as "Type 2 diabetes". The term "pre-diabetes" was coined to provide early awareness of the developing disorder so individuals may reduce their likelihood of progressing to developing Type 2 diabetes and the associated macrovascular and microvascular complications.

Type 1 diabetes

Type 1 diabetes mellitus (T1DM) was formally called Insulin Dependent Diabetes Mellitus (IDDM) or Juvenile-Onset Diabetes. This form of diabetes accounts for 10-15% of all types of diabetes and 0.2-0.3% of the Australian population. In patients with Type 1 diabetes, the pancreas does not produce enough insulin to regulate blood glucose levels. This results in inadequate glucose uptake into the cells for energy and an accumulation of glucose in the blood. Patients with Type 1 diabetes are required to take daily injections of insulin.

Type 2 diabetes

Type 2 diabetes mellitus (T2DM) was formally called Non-Insulin Dependent Diabetes Mellitus (NIDDM) or Adult-Onset Diabetes. This form of diabetes accounts for 85-90% of all types of diabetes and greater than 7% of the Australian population. Type 2 diabetes is a condition that is a progressive insulin secretory defect on the background of insulin resistance. This is where your body is able to produce insulin however is unable to use the insulin it produces. However, some patients also have inadequate insulin production. Type 2 diabetes can be controlled through diet and exercise alone although in many cases, often more advanced stages require the use of oral medication(s) and/or insulin.

Gestational diabetes

Gestational diabetes is a type of diabetes that occurs during pregnancy in women who otherwise do not have diabetes. It is primarily associated with insulin resistance brought about by hormonal levels blocking the action of insulin. Women typically develop gestational diabetes during the 24th to the 28th week of pregnancy and women with gestational diabetes are at an increased risk of developing Type 2 diabetes. It affects approximately 4% of all pregnant women.

Pre-diabetes

Before the development of Type 2 diabetes, nearly all people have pre-diabetes. There are two types of "pre-diabetes"; impaired fasting glucose (IFG) and impaired glucose tolerance (IGT). It is estimated that approximately two million Australians have either IFG or IGT, which if undiagnosed will progress to Type 2 diabetes.

Impaired fasting glucose: is determined via a fasting blood glucose test where your test result is between ≥ 6.1mmol/L and ≤ 6.9mmol/L. This result is higher than normal however it does not meet the diagnostic criteria for diabetes. Impaired fasting glucose can also be determined by an oral glucose tolerance test where the initial, fasting reading is ≥ 6.1mmol/L. and ≤ 6.9mmol/L .

Impaired glucose tolerance: can only be determined by an oral glucose test. This is where the two hour reading is higher than normal however it does not meet the dignostic criteria for diabetes. Impaired glucose tolerance is diagnosed if your two hour reading is between ≥ 7.8mmol/L and ≤ 11.0mmol/L .
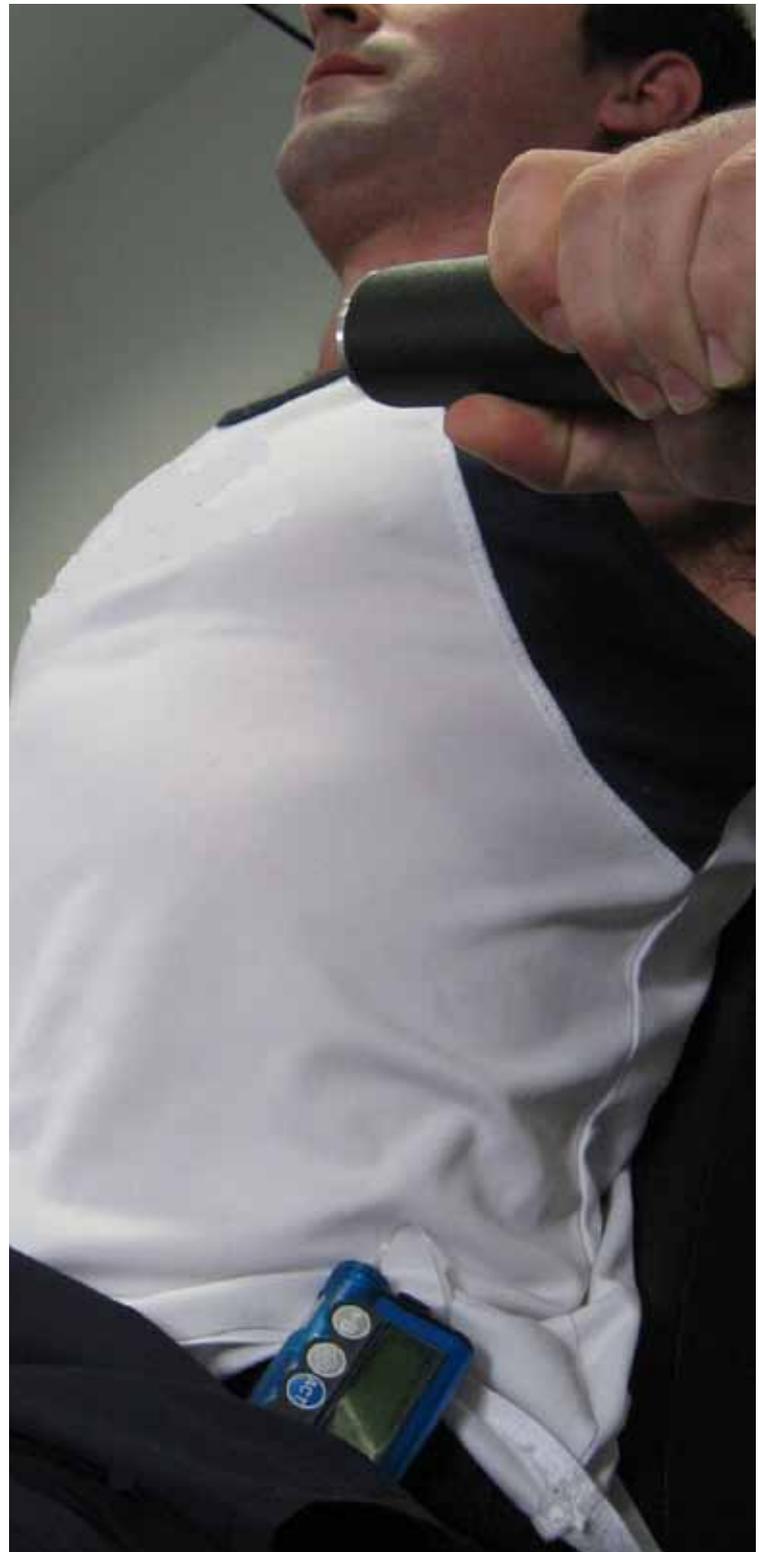
» *Treatment*

Type 2 diabetes

Treatment of patients with Type 2 diabetes has generally focused around efforts to maintain or improve glycaemic control, with the symptoms of co-morbidities and complications also being targeted (although often in isolation from the glycaemia itself). Traditionally, treatments for diabetes have centred on the use of pharmaceutical interventions, and in many cases these have proven to be lifesaving. Pharmaceutical intervention initiates with the administration of oral antihyperglycaemic agents and then progresses to the inclusion of insulin therapy when insulin production from the pancreas further diminishes. Sulfonylureas fall into the antihyperglycaemic agent category. This drug facilitates insulin production in the pancreas reversing the attenuating insulin production. Metformin, a Biguanide, is considered an insulin sensitiser, and is believed to reduce hepatic glucose production. Metformin does not promote insulin secretion like sulfonylureas. Thiaszolidinediones (TZD) cause an increase in insulin stimulated glucose uptake perhaps, to a greater extent than metformin, without promoting insulin release. Other medications include Alpha-glucosidase inhibitors and non-sulfonylurea secretagogues. Alpha-glucosidase inhibitors delay intestinal carbohydrate absorption and mitigate postprandial glucose exercursions, whereas non-sulfonylurea secretagogues behave in a similar manner to sulfonylureas, although for shorter durations.

Side effects

Very few of the available drugs for patients with Type 2 diabetes mentioned above are free of side effects. In addition, both insulin and oral antihyperglycaemic agents can potentially cause hypoglycaemia if used incorrectly, especially when used in conjunction with poor dietary management. Sulfonylureas can cause hypoglycaemia and weight gain which is problematic given the majority of patients with T2DM are overweight. There is also the potential for sulfonylureas to accelerate pancreatic exhaustion. Metformin can cause gastrointestinal distress, although the need to discontinue therapy is uncommon. It is generally not prescribed to patients who have renal impairment as it increases the risk of lactic acidosis and is contraindicated in hepatic dysfunction, congestive heart failure, metabolic acidosis, dehydration and alcoholism.

In contrast to medication, lifestyle modification is associated with very few side effects. Aside from muscle soreness and fatigue that may occur as a result of unaccustomed exercise, lifestyle changes are recognised as a viable, safe and potentially more effective and economical alternative to pharmaceutical interventions in the prevention and management of diabetes.

Lifestyle modification

Lifestyle modification, including a controlled diet and regular exercise, can effectively manage Type 2 diabetes without the need for medication in the early stages of the disease. In the advanced stages of the disease, lifestyle modification can reduce the dependence on medication and it is widely accepted that these changes form an integral component of management in patients with Type 2 diabetes. This management also extends to the major complications and co-morbidities of Type 2 diabetes, where lifestyle modifications are also considered essential, not only in the primary, but also in secondary prevention.

» Diet

A healthy diet along with an appropriate exercise plan is crucial for an enhanced primary health plan in diabetes management. Consuming a small serve of low glycaemic index (GI) carbohydrate based food at each meal, eating regularly throughout the day (to keep blood glucose levels consistent), focusing on foods low in fats (in particular, saturated fats) to reduce heart disease risk, including fibre-rich foods, and drinking enough water are the main areas to focus on. Most people with Type 2 diabetes need to reduce their weight (body fat), hence overall kilojoule balance is also an important factor.

Choose low glycaemic index (GI) foods

In the past, dietitians classified carbohydrate-rich foods as either simple or complex. Nowadays, the Glycaemic Index (GI) system is more commonly used, whereby foods are grouped into low, moderate, or high GI categories. Foods that have a low GI are slowly absorbed, making the release of glucose into the blood stream from these foods gradual and sustaining, and the decrease just as gradual. These foods can prevent rapid rises in blood glucose levels, and have a higher degree of satiety (filling us up for longer) thereby assisting in weight loss. To maintain optimal blood glucose control, low GI foods are recommended. On the other hand, foods that are quickly absorbed and released into the bloodstream are termed high GI. These foods are recommended only as "occasional" foods for those with diabetes (pre-diabetes, Type 1, Type 2), however, are used by insulin-requiring people (mainly those with Type 1 diabetes) to quickly increase their blood glucose levels when their blood glucose levels drop too low (called "hypoglycaemia"). Regardless of these general reactions to food, it is important for people with diabetes to individually test their own blood glucose responses to different foods, as some may respond adversely to a few low GI foods.

GI ranges

High GI	**>70**
Moderate GI	**55 – 70**
Low GI	**<55**

High GI foods include: white bread, scones, rice cakes, Coco Pops, watermelon, jelly beans and sports drinks. Moderate GI foods include: crumpets, one minute oats, pineapple, sultanas, and Basmati rice. Low GI foods include: apples, pears, sweet potato, sweet corn, traditional rolled oats, pasta, lentils, kidney beans, milk and yoghurt. For a full database on the GI of most foods, refer to http://www.glycemicindex.com/

Both the amount and type of carbohydrate eaten will affect blood glucose levels. Although a food may be low GI and low fat, if it is eaten in excessive quantities, the total amount of carbohydrate ingested for that meal may still cause increased blood glucose levels. In addition, overeating will lead to weight gain (or prevent weight loss) which prevents insulin from working as well as it should. Those with diabetes are encouraged to consume small portions of low GI foods throughout the day.

People prescribed insulin as part of their diabetes management (Type 1 and Type 2) need to ensure their insulin dose matches their blood glucose level and carbohydrate intake, to maintain optimal blood glucose control. This requires knowledge of how much carbohydrate is in different foods of different portion sizes.

Reduce fat intake

It is also important to pay attention to the fat content in foods and meals consumed. Reading labels, and comparing levels per 100g is a great start. Where possible, choose lower fat products. Ideally foods with lower saturated fat content should be chosen – these are listed under Total Fats on the Nutrition Information Panel on most foods. Saturated fats have greater potential than unsaturated fats (polyunsaturated and monounsaturated) to increase cholesterol levels, particularly LDL (or "bad") cholesterol levels. Foods of animal origin (e.g. dairy and meat based) are sources of saturated fat so choose low fat or lean products to minimise intake. The Baker IDI Heart and Diabetes Institute recommend the following levels of fats in foods:

Total fat

Less than or equal to 5g/100g, if mainly saturated fats OR up to 10g fat/100g, if most of the fat is mono- or poly-unsaturated. However, there are some exceptions, e.g. for milk and yoghurt, the best choice are those with less than or equal to 2g fat/100g. For cheese: less than or equal to 15g/100g fat.

Practical ways to reduce fat intake

- Minimise intake of sweet biscuits, cakes, chocolates and chips.
- Use reduced fat dairy products from the age of two years (i.e. milk, yoghurt, custard and cheese).
- Remove the fat from meat and skin from chicken, and choose lean cuts.
- Enjoy two to three fish meals weekly to increase polyunsaturated fat intake (including omega 3's). Pregnant women, however, need to limit intake of certain types of fish.
- Use small amounts of "healthy" oils for cooking, such as olive, sunflower or canola oil, instead of saturated fats like butter.

Watch alcohol intake

Alcohol contains a high kilojoule content, which can hamper weight loss. If trying to reduce weight, ensure you have a maximum of one standard drink daily if you are a woman, and two for men. Hypoglycaemia (low blood glucose) can occur after ingestion of alcohol for people with diabetes on insulin or medication for diabetes. It is advisable to consume alcohol in moderation with a small snack of carbohydrate-rich food, and adhere to the recommendation of two alcohol free days weekly.

Ensure a balance of other nutrients

Although not specifically related to diabetes, foods that are rich in calcium and iron, and high in fibre, are also essential for good health. For more great tips on these nutrients, refer to the Sports Dietitians Australia fact sheets on Bone Health and Iron.

* For more specific dietary advice, see a sports dietitian. Go to http://www.sportsdietitians.com.au/findasportsdietitian

* For more information on the Glycaemic Index, refer to the Sports Dietitians Australia fact sheet at http://www.sportsdietitians.com.au/resources/upload/GI_and_sports_performance.pdf

* For more information on diabetes and diet, see: http://www.diabetesaustralia.com.au/Living-with-Diabetes/Eating-Well/

» Exercise

Aerobic exercise is typically repetitive movements involving large muscle groups and is aimed at improving aerobic fitness, for example, walking, swimming and cycling. On the other hand resistance training is often referred to as weight training, which too involves large muscle groups, although aims at improving muscle strength and size.

Exercise is strongly advocated for all patients with diabetes provided their blood glucose and diabetes complications are controlled. To target improvements in glycaemic control, help to reduce body fat and improve cardiovascular health patients with diabetes should aim to achieve the following exercise recommendations:

Cardiorespiratory exercise

At least 150min of at least moderate-intensity cardiorespiratory exercise each week and/or at least 90 minutes of at least vigorous-intensity cardiorespiratory exercise each week. Patients should exercise on at least three days each week with no more than two consecutive days without exercise. These guidelines may be achieved through various combinations or moderate or vigorous-intensity exercise. For example in a given week patients may exercise at a moderate intensity for 30 minutes twice a week with an additional 20 minutes of vigorous intensity exercise on two more occasions in the same week.

Resistance exercise

Additionally patients with Type 2 diabetes should be encouraged to achieve three resistance training sessions each week with the goal of exercising all the major muscle groups and progressing to 8-10 repetitions at a weight that can be lifted for a maximum of 8-10 repetitions.

Despite these guidelines, it should be noted that in some instances patients with Type 2 diabetes may not be able to meet the recommended exercise target. In such situations patients should be encouraged to exercise within their physical limitations and achieve as much exercise as possible, hopefully progressively increasing their exercise levels to the minimum target outlined above.

» Blood Glucose Monitoring

Self monitoring blood glucose testing is recognised as an invaluable diabetes management tool for all diabetics which assists in monitoring the effectiveness of diabetic medications, dietary influences, and the effectiveness of exercise. Blood glucose monitoring is particularly important with regard to exercise to minimise the likelihood of developing hypoglycaemia which occurs as a side effect of several diabetes medications (oral hypoglycaemic agents and insulin). Hypoglycemia can result when an individual's blood sugar reading is ≤ 4.0mmol/L however, the onset of symptoms of hypoglycaemia varies between individuals.

To avoid hypoglycaemia associated with exercise it is recommended that blood sugar readings be taken immediately prior to initiating exercise, intermittently throughout exercise, and upon the cessation of the exercise session. Hypoglycaemia can be delayed and occur up to 24 hours post-exercise, this occurs as a result of insulin deficiency, increased insulin sensitivity, or depleted glycogen stores. Therefore, post-exercise blood glucose monitoring is particularly important to avoid hypoglycaemic events.

It is advisable if the pre-exercise blood glucose reading is < 5.6mmol/L, to injest carbohydrate to avoid hypoglycaemia during the exercise session. If you are using a continuous glucose monitoring system, it is prudent to set the alarm at a slightly higher blood glucose level as research has found these devices have a five minute lag time.

People with Type 1 diabetes or those individuals who are Type 2 however also use insulin should plan ahead with exercise as there is a higher likelihood of exercise induced hypoglycaemia. Hypoglycaemia can be avoided by carrying a rapidly absorbing high glycaemic index (high GI) carbohydrate if they either feel the onset of symptoms suggestive of hypoglycaemia or have a low blood glucose reading during exercise. Exercise is contraindicated when blood glucose levels are > 15.0mmol/L or when ketones are present. See you general practitioner or endocrinologist should this occur.

For more specific exercise advice, see an Accredited Exercise Physiologist. Go to http://www.essa.org.au to find one in your area. For further information visit:
http://circ.ahajournals.org/cgi/content/short/119/25/3244 and http://care.diabetesjournals.org/content/33/Supplement_1/S11.full.pdf+html

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