Diet and diabetes

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Background

Guidelines for the prevention and management of type 2 diabetes mellitus (T2DM) reinforce lifestyle management, yet advice to guide general practitioners on principles around dietary choices is needed.

Objective

This article provides current evidence regarding the differing diets in diabetes prevention and management once T2DM arises, including the role in management of complications such as hypoglycaemia.

Discussion

Diets should incorporate weight maintenance or loss, while complementing changes in physical activity to optimise the metabolic effects of dietary advice. Using a structured, team-care approach supports pragmatic and sustainable individualised plans, while incorporating current evidence-based dietary approaches.

Diabetes mellitus is expected to be the leading cause of chronic disease in Australia by 2023. Being overweight or obese carries significant risks for developing type 2 diabetes mellitus (T2DM). Lifestyle modification remains the bedrock of management of T2DM and its related comorbidities in Australian and international treatment guidelines.[1,2] Once T2DM develops, the combination of diet, lifestyle changes and physical activity has a major impact on glycaemic control, weight management and complication prevention.

The role of diet in diabetes prevention

It is estimated that 16.4% of Australians have prediabetes.[3] This is defined as impaired fasting glucose (IFG) and impaired glucose tolerance, or an HbA1c of 6.0–6.4% (42– 46 mmol/mol).[4] Prediabetes carries an independent risk for cardiovascular disease, separate from the risks of developing T2DM.[3] Thus, prediabetes risk prevention must address the prevention of cardiovascular risks as much as managing progressive dysglycaemia.[3]

Most diabetes prevention studies (*Table 1*) included dietary components to the intervention. Changes in levels of physical activity and, in some cases, addition of pharmacological interventions, make it difficult to define the independent effect of dietary changes in the prevention of type 2 diabetes.[5] However, of the dietary changes used in these studies, the Finnish Diabetes Prevention Study[6] gives some insights. Rates of diabetes risk reduction were highest in people who achieved the greatest adherence to:

- weight reduction >5%
- fat intake <30% of total energy intake
- saturated fat intake <10% of total energy intake
- dietary fibre intake ≥15 g/1000 kcal
- at least moderate intensity exercise for >4 hours weekly.

From the intervention over 6 years, the relative risk reduction in progression to diabetes was 31% in the diet group, 46% in the exercise group and 42% in the combination group, suggesting that an appropriate strategy of physical activity and/or dietary changes aimed at promoting weight loss can prevent diabetes. It is estimated that weight loss of 5 kg in all people who are overweight or obese would reduce the national prevalence of T2DM by 15%.[7]

When dietary saturated fats are decreased and replaced by polyunsaturated fatty acids (PUFAs) there are significant reductions in the risks of developing diabetes.[8] Additionally, a recent study analysing the independent effect of the Mediterranean diet on prediabetes development[9] showed that this diet supplemented with extra virgin olive oil reduced the development of prediabetes by 40%, compared with a control diet.

The National Health and Medical Research Council (NHMRC) Australian Dietary Guidelines 2013[7] assesses the effects of diet on diabetes prevention. Consumption of sugar-sweetened drinks increases the risk of developing T2DM. Consumption of cereal foods (especially three serves a day of wholegrains) is associated with reduced risk of T2DM. This evidence supports three serves per day of wholegrain foods conferring a risk reduction of 21–42%. In some people, consumption of four cups of coffee per day reduces the risk of diabetes through unknown mechanisms. Two to four serves of dairy foods (milk, cheese, yoghurt) per day is associated with reduced risk of metabolic syndrome and consumption of at least 1.5 serves of milk, cheese and yoghurt per day is associated with reduced risk of T2DM.

Cardiovascular risk reduction is imperative in prediabetes and, as such, the Mediterranean diet seems to have the best overall evidence of long-term effects on cardiovascular risk reduction.[8,10–14]

Dietary management when patients develop T2DM

The most successful nutritional strategy for prevention and treatment of T2DM is one that is individualised, that takes into consideration culture, food availability and personal preferences, but follows recommendations that encourage a variety of foods from the five main food groups each day. Australian guidelines[7] give similar advice for diabetes prevention, recommending that saturated fats should be minimised. Conversely, dietary fat quantity or quality has minimal direct influence on glycaemic control but may contribute to metabolic effects such as weight gain and obesity, which may affect glycaemic control in the longer term.

Extreme dietary restriction and avoidance of certain food groups, such as very low dairy or grain-free diets, might achieve short-term weight loss but do not represent a sustainable balanced diet plan. Ideally, the diet should be sustainable and be able to be maintained over the long term to provide adequate amounts of nutrients and kilojoules to maintain ideal weight, help stabilise blood glucose levels and assist in the maintenance of an optimal lipid profile.

Dietary advice should address intake of fruit and vegetables, unrefined grains with natural high-fibre content, vegetable oils with low content of saturated fat (such as olive oil), nuts, legumes, low-fat dairy and fish as sources of protein, and limit the intake of highly processed foods.[15]

Weight management should be a priority, particularly visceral fat reduction, in those who are overweight or obese. Visceral

Table 1. A summary of diabetes prevention studies

Study	Number of participants	Intervention	Treatment	Risk reduction
Da Qing IGT and Diabetes Study[27]	577	Diet and exercise	6 years, follow-up at 20 years	34–69%
Finnish Diabetes Prevention Study[6]	522	Diet and exercise	3 years, follow-up at 7 years	58%
Diabetes Prevention Program[28]	3234	Diet, exercise and metformin	2.8 years, follow-up at 10 years	31–58%
Indian Diabetes Prevention Programme[29]	531	Diet, exercise and metformin	3 years	26.4–28.4%
Predimed[9]	3541	Mediterranean diet with: • EVOO* • nuts versus control diet	4 years	• 40% • 18% Prediabetes as a secondary endpoint

**EVOO, extra virgin olive oil*

adiposity (and its accompanying inflammatory processes) contributes to significantly increased insulin resistance and complication progression.

Physical activity acts independently and synergistically with attempts to control weight regain achieved through nutritional interventions. Total reduction of kilojoule intake achieves this aim, independently of the macronutrient component of the diet. The NHMRC Australian Dietary Guidelines 2013 has a pictorial guide to assist with the education of patients.

Guiding patients to make a choice

Use of the 5As approach (Ask, Assess, Advise, Assist and Arrange),[16,17] will allow the general practitioner (GP) to adopt a plan that considers individual, cultural and lifestyle factors in guiding food choices, using a team-based approach to dietary support, including the use of a dietician, exercise physiologist and specialist care services (eg for a very low energy diet or bariatric surgery pre- and post-surgical care). These principles are further explained in the Royal Australian College of General Practitioners' *Smoking, nutrition, alcohol, physical activity* (SNAP) guidelines.[17]

Various popular dietary approaches

Mediterranean diet

A Mediterranean diet is one that comprises at least two of the following components:[13]

- high monounsaturated:saturated fat ratio
- low-to-moderate red wine consumption
- high consumption of legumes
- high consumption of grains and cereals
- high consumption of fruits and vegetables
- low consumption of meat and meat products and increased consumption of fish
- moderate consumption of milk and dairy products.

A kilojoule-reduced Mediterranean diet may achieve weight loss and may show improvement in blood pressure control and triglyceride levels. The benefit of a Mediterranean diet is that it is flexible and can suit a vegan, vegetarian or meat-eater.

Low carbohydrate diets

These diets have different descriptions in clinical trials, making broad judgments of their effectiveness difficult. Examples include:

- low-carbohydrate ketogenic diet (LCKD): <50 g of carbohydrates (10% kilojoules) daily
- low-carbohydrate diet (LCD): 50–130 g carbohydrates (10–26% of kilojoules) daily
- moderate carbohydrate diet (MCD): 130–225g carbs daily (26–45% of kilojoules) daily.

Across this range, however, the effects on improved glycaemia and weight reduction may be mainly due to kilojoule restriction.[18–20] Longer term studies have not revealed any prolonged superiority of these diets in complication risk reduction and short-term studies have not revealed any risk increase.[19,20]

Intermittent or alternate day fasting versus continual calorie restriction (CCR)

Despite the popularity of the 5:2 diet, a review[21] has found no meaningful differences in glucose control. There was more weight loss with CCR but each diet produced comparable reductions in visceral fat weight. The authors concluded that more research is needed to see if there are benefits specific to T2DM. Significantly, fasting may need careful assessment to avoid hypoglycaemia in patients on oral sulphonylureas or insulins.

Very low energy diets (VLED)

Very low-energy diets may be a useful intensive intervention that is effective in achieving weight loss. According to the NHMRC guidelines,[16] VLED may be considered in adults with a BMI >30 kg/m^2, or with a BMI >27 kg/m^2 and T2DM. Rather than self-management, referral to specialist care services would be recommended for this approach.

Low glycaemic index diet

The effect of foods with a low glycaemic index has been studied in T2DM[22] and there is some evidence for benefit through a reduction in HbA1c levels of up to 0.5% and fewer hypoglycaemic events. However, this dietary approach did not achieve additional weight loss, compared with high glycaemic index or load diets.

Alcohol

Given the additive effects of alcohol and hypoglycaemia on behaviour and cognitive function, it is recommended that people with diabetes not consume alcohol when driving. Alcohol may aggravate accompanying comorbidities, including liver disease and neuropathy – so adherence to the Australian Alcohol guidelines[23] is advisable, as is discussion with the diabetes health professional team members.

Low kilojoule sweeteners

A meta-analysis of multiple trials[24] showed a small amount of weight loss with the use of low-kilojoule sweeteners. Use of such sweeteners could be helpful for weight maintenance for patients with T2DM, but there is a lack of evidence that they may assist in preventing complications of T2DM.

Patients using insulin

The total carbohydrate intake at a meal correlates closely with postprandial glycaemia, but improving glycaemic control by limiting the carbohydrate intake alone has not been supported by high-quality studies.[25] However, understanding the patterns of carbohydrate consumption and self-monitoring of blood glucose (SMBG) may be helpful for patients using mealtime or prandial rapid-acting insulin, as suggested in UK guidelines.[25] In patients with unstable T2DM on insulin, the use of low carbohydrate

dietary approaches, including ketogenic diets, may cause hypoglycaemia, complicating the matching of glucose self-monitoring to medical supervision of insulin dose adjustment.

Diet and hypoglycaemia[1]

If the blood glucose levels (BGL) is <4.0 mmol/L and the patient is symptomatic, awake and can swallow, manage according to the Rule of 15:[1]

- Provide 15 g of quick-acting carbohydrate that is easy to consume (eg half a can of regular (non-diet) soft drink, half a glass of fruit juice, 3 teaspoons of sugar or honey, 6–7 jellybeans, 3 glucose tablets).
- Wait 15 minutes and repeat blood glucose check. If the level is not rising, suggest eating another quick-acting carbohydrate from the above list.
- If the patient's next meal is more than 15 minutes away, provide some longer acting carbohydrate (eg a sandwich, 1 glass of milk or soy milk, 1 piece of fruit, 2–3 pieces of dried apricots, figs or other dried fruit, 1 tub of natural low-fat yoghurt, 6 small dry biscuits and cheese).
- Test glucose again during the next 2–4 hours.

Diet and nephropathy

A meta-analysis[26] of 13 randomised trials involving 779 patients showed some evidence that a lowered protein diet assisted with diabetic nephropathy, when patients adhered to this diet. Management of hypertension through the use of pharmacotherapy and a sodium restricted diet, in addition to tight glycaemic and lipid control underpin the long-term prevention of this condition.

Summary

What is the ideal diet for prevention and the management of T2DM? It remains an individualised, sustainable dietary plan that achieves and maintains an ideal weight range, while addressing major comorbidities such as cardiovascular disease. Differing dietary approaches to kilojoule restriction, (including VLED approaches) act synergistically with increasing physical activity to help address weight management. Of all approaches, the Mediterranean diet has accumulated evidence showing cardiovascular risk reduction. Implementing a structured approach using a 5As, team-based approach will allow a GP to provide a supportive framework to integrate these principles to support the increasing number of identified patients needing dietary advice.

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