Diets for diabetes
A rational approach

PETER CLIFTON FRACP, PhD

Weight loss provides clear long-term benefits for glycaemic control in people with type 1 or type 2 diabetes. Carbohydrate restriction by replacement with unsaturated fats and protein is one approach to diet in these patients.

Key points

- **The diet of people with type 1 or type 2 diabetes has been controversial for many decades.**
- **Carbohydrate restriction can help some patients with brittle type 1 diabetes.**
- **Carbohydrate restriction in people with type 2 diabetes may lower triglyceride levels, increase HDL-cholesterol levels and lower HbA_{1c} but results can be very variable.**
- **Weight loss lowers HbA_{1c}, blood pressure and lipid levels in people with type 2 diabetes but does not reduce heart disease and stroke over 10 years.**

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Professor Clifton is Professor of Nutrition at School of Pharmacy and Medical Sciences, Sansom Institute, The University of South Australia, Adelaide, SA.

What a person with type 1 or type 2 diabetes should eat has been controversial for many decades and recommendations on fat and carbohydrate amounts to be eaten have swung between extremes of both. This article provides evidence for approaches to diet based on clinical trials with current data supporting some degree of carbohydrate restriction by replacement with unsaturated fats and protein.

Type 1 diabetes

People with type 1 diabetes are at risk of cardiovascular disease and need a diet that will minimise this risk. This means consuming unsaturated fats (instead of saturated, mostly animal, fats), nuts, fruits, vegetables and fibre, as well as undergoing exercise and controlling weight. Carbohydrate amount is clearly important in determining insulin dose but this is a very individual issue and depends on both the person and the form of carbohydrate, and often requires some experimentation. The usual insulin dose range is 0.5 to 3 units per 10 g of carbohydrate and the usual starting dose is 1 unit per 10 g. For most people, 10 g of carbohydrate will raise their blood glucose level by 3 to 4 mmol/L and 1 unit of insulin will lower it by 4 mmol/L. The addition of fat or protein to the meal will slow gastric emptying and slow the rise in glucose levels, as will the use of low glycaemic index (GI) foods. Quick-acting (prandial) insulins may need to be reduced for these meals. However, there may be a delayed rise in blood glucose. Careful checking of finger prick glucose levels before and after the meal may be required to determine individual responses to a meal.

Some people find matching insulin dose to carbohydrate amount very difficult and dramatically reduce both to smooth out the fluctuations, improve control and reduce episodes of hypoglycaemia.[1-3] This technique has been strongly advocated by Dr Bernstein, a physician with type 1 diabetes.[4] Carbohydrate amounts with this diet may vary from 50 to 100 g/day, depending on the strictness of the diet. Note that virtually all diabetes organisations follow the recommendations from the Institute of Medicine of a recommended dietary allowance of 130 g/day of carbohydrate based on the brain's requirement for glucose. However, the report states that this excludes

any use of keto acids by the brain and also excludes the contribution that gluconeogenesis from amino acids and glycerol can make and therefore is theoretical only.

In conclusion, for type 1 diabetes, carbohydrate restriction may be of value for some patients with brittle diabetes. For the rest, knowledge of carbohydrate intake is important to match it with the right insulin dose.

Type 2 diabetes

What do the negative studies say?

The most recent Cochrane review investigating dietary advice for treatment of type 2 diabetes (2007) examined 18 randomised controlled trials of six months or longer. It concluded that there is no good evidence for any particular type of diet for adults with type 2 diabetes.[5]

A meta-analysis designed to investigate the effects of two types of prescribed diets (a low-fat, high-carbohydrate diet and a high-fat, low-carbohydrate diet) reviewed 19 short-term studies (of less than 12 weeks duration) with 306 participants.[6] Changes in values for HbA_{1c}, fasting plasma glucose, total cholesterol and LDL-cholesterol did not differ significantly between the two diet groups. However, the low-fat, high-carbohydrate diet significantly increased fasting insulin and triglyceride levels by 8% ($p = 0.02$) and 13% ($p<0.001$), respectively, and lowered HDL-cholesterol by 6% ($p<0.001$) compared with the high-fat, low-carbohydrate diet.[6]

What do the positive studies say?

A limited (as some trials of low glycaemic load were omitted) Cochrane review examining 402 people with type 2 diabetes on a low-GI or low-glycaemic load diet of four weeks or longer in 11 different trials found that a low-GI or low-glycaemic load diet significantly reduced HbA_{1c} by 0.5%.[7] Episodes of hypoglycaemia were also significantly fewer with a low-GI diet compared with a high-GI diet in one trial.[7] However, this was not confirmed in a 12-month trial in which long-term HbA_{1c} was not affected by altering GI or the amount of carbohydrates.[8] A six-month trial from the same group of authors showed that a low-GI diet lowered HbA_{1c} by 0.32% compared with a high wheat-fibre diet ($p<0.05$).[9]

A meta-analysis reviewed 13 studies on diets with different carbohydrate amounts that were all less than 26 weeks in duration.[10] Meta-regression analyses show that HbA_{1c}, fasting glucose and triglyceride levels significantly improved with lower carbohydrate-content diets.

Another recent review examined 20 trials of over six months duration and concluded that low-GI, Mediterranean and high-protein diets led to some benefit in glycaemic control, significantly reducing HbA_{1c} by 0.12 to 0.47%.[11] These diets were also of benefit for weight loss, with the Mediterranean diet leading to the greatest amount of weight loss.

A meta-analysis focusing on nine trials in 1547 people with type 2 diabetes, insulin resistance and impaired glucose intolerance with a duration of six months or more showed that high-monounsaturated fatty acid diets led to a reduction in HbA_{1c} of 0.21%, with no effect on fasting glucose or insulin levels.[12]

A study from Italy investigating 215 overweight people with newly diagnosed type 2 diabetes showed that after four years, 44% of patients in the Mediterranean diet group required medication as indicated by an HbA_{1c} of more than 7% (the threshold for medication) compared with 70% of patients in the standard high-carbohydrate, low-fat diet (the difference was significant; $p<0.05$).[13]

These data suggest that any diet reducing glycaemic excursions by replacing carbohydrate with unsaturated fat or protein or reducing the GI of the carbohydrate improves diabetes control and this strategy is frequently advocated.[14] The data seem to be strongest for the high monounsaturated fat, high legume Mediterranean diet. The higher protein approach, although not recommended by the American Diabetes Association, Diabetes UK or Canadian Diabetes Association, would appear not to cause short-term harm in people with type 2 diabetes, and the Joslin clinic (Boston, USA) uses a low-carbohydrate, high-protein diet (30% of calories compared with the usual 15 to 18%).[15] In general, the diet of people with diabetes is no different from those without diabetes, despite widely varying advice for people with diabetes.

In the Look AHEAD (Action for Health in Diabetes) study cohort of 2757 overweight or obese participants, which is a typical diabetic population, 93% of participants exceeded the recommended percentage of calories from fat, 85% exceeded the saturated fat recommendation, and 92% consumed too much sodium.[16] Also, fewer than half met the minimum recommended servings of fruit, vegetables, dairy and grains. Fruit intake has no effect on diabetes control in newly diagnosed patients.[17]

Weight loss

Weight loss regardless of how it is achieved leads to good reductions in HbA_{1c}. The Look AHEAD study is the biggest combined weight loss and exercise study. Participants in the intensive lifestyle intervention group lost significantly more weight than the diabetes support and education control group (net difference of -7.9% at one year and -3.9% at four years).[18-21] HbA_{1c} dropped by 0.6% at one year and 0.1% at four years in the intervention group compared with the control group (mean difference over four years of 0.27%).[19-21] In the intensive group, 9.2% had continuous sustained remission from diabetes for at least two years, 6.4% for at least three years and 3.5% for at least four years, compared with less than 2%, 1.3% and 0.5%, respectively, in the diabetes support and education control group.[18] A total of 887 participants in the intensive group lost 10% or more of their initial weight at year one, of whom 374 (42.2%) maintained this loss at year four.[19] Participants who maintained the loss, compared with those who did not, attended more treatment sessions and reported more favourable physical activity and food intake at year four so the benefit was achieved through diet and physical activity.[19] The trial has now stopped because there was no difference in cardiovascular events between the groups; however, benefit of the intervention may not be seen for at least 10 years, although advanced kidney disease has already been reduced by 31% and diabetic retinopathy by 14%.[22]

Conclusion

Weight loss provides clear long-term benefits for glycaemic control in patients with type 1 or 2 diabetes in recent trials. Both low-GI diets and low-carbohydrate diets may be helpful in the short to medium term, but there is a lack of long-term trial evidence. Triglyceride levels can be lowered by a reduced carbohydrate diet with increased unsaturated fats and protein. **ET**

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