

Dietary interventions and weight reduction in people with type 2 diabetes

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Article points

1. There are no apparent differences in effect for different diets and both Diabetes UK and the American Diabetes Association now recommend that a variety of strategies are suitable for promoting weight loss in people with diabetes.
2. Recent randomised controlled trials have shown significant improvements in glycaemic control associated with weight loss over both the short and long-term.
3. Lifestyle interventions are effective for weight loss, improving glycaemic control and reducing cardiovascular risk in people with type 2 diabetes, although there is no evidence for the most effective dietary strategy.

Key words

- Diet
- Glycaemic control
- Weight loss

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The term “diabesity” is used to describe coexistent type 2 diabetes and obesity. The number of people with both conditions has significantly increased over the past few decades and it is now more important than ever to encourage people to lose weight or maintain a healthy weight. Weight loss has been shown to improve glycaemic control, reduce cardiovascular risk and reduce all-cause mortality. There is a wide range of diets currently available; this article reviews these dietary interventions, explores the evidence underpinning their efficacy, and assesses their suitability for people with type 2 diabetes.

Diabetes was estimated by the International Diabetes Federation (IDF) to affect 285 million people worldwide in 2010 (6.6% of the population) and is predicted to increase to 439 million (7.8%) by 2030 (IDF, 2009). In the UK, approximately 2.8 million people (4.3%) were living with diagnosed diabetes in 2010, based on data from the Quality and Outcomes Framework (NHS Information Centre, 2010). Type 2 diabetes accounts for 85–95% of all diabetes (Diabetes UK, 2010), and as a recent study has shown that 50% of people with type 2 diabetes are obese (Haslam, 2011), this means that there are approximately 1.26 million people with type 2 diabetes and obesity in the UK.

The coexistence of type 2 diabetes and obesity is termed “diabesity”, and over the past few decades the evidence showing that overweight and obesity are risk factors for type 2 diabetes has continued to accumulate (Colagiuri, 2010). There is general agreement that weight loss is effective in both the prevention and treatment of type 2 diabetes (American Diabetes Association [ADA], 2008; Dyson et al, 2011), and that weight loss can

improve glycaemic control, reduce cardiovascular risk, and reduce all-cause mortality by 25% in people with type 2 diabetes (Aucott et al, 2004). It is, however, important to note that the relationship between blood glucose and weight is not always straightforward; weight loss can also be an indicator of poor glycaemic control. One of the challenges in managing diabesity is that a number of the therapies to improve glycaemic control are associated with weight gain. Sulphonylurea and thiazolidinedione therapy are associated with mean weight gain of 3 kg (Bolen et al, 2007) and insulin therapy is associated with a mean 5 kg weight gain (Holman et al, 2007).

In the UK, algorithms have been produced recommending a treatment cascade for those with type 2 diabetes; this begins with a trial of lifestyle interventions before introducing medication (NICE, 2009). Despite this recommendation, and the evidence that dietary interventions have small but significant effects on weight loss (Aucott et al, 2004), many authorities dismiss lifestyle interventions as ineffective in treating obesity and bemoan the lack of effective pharmaceutical

agents (Bailey, 2011). This is partly due to the lack of evidence regarding the most effective dietary intervention to treat type 2 diabetes (Nield et al, 2007); in addition, as most studies have methodological flaws (such as: small numbers of participants, lack of a control group, short-term follow-up, and high attrition rates), it is difficult to draw firm conclusions for clinical practice.

Studies investigating the effect of weight loss in type 2 diabetes have used a variety of strategies, including low-fat diets (also known as “healthy eating”), low carbohydrate diets, low glycaemic index diets, Mediterranean diets, very low calorie liquid diets (VLCLD), meal replacements and commercial diet groups. However, there are few head-to-head randomised controlled trials evaluating different dietary approaches in people with type 2 diabetes, making it difficult to draw conclusions about the most effective dietary intervention for the clinical management of diabetes.

Weight loss

Despite a large body of literature comparing weight loss strategies in people without diabetes, there

are few comparator studies in people with type 2 diabetes. *Table 1* shows a summary of weight loss by various strategies in obese and overweight people with type 2 diabetes. These data are based on a variety of sources including meta-analyses, reviews and large epidemiological and randomised controlled trials. A true comparison of effect by meta-analysis could not be performed as these studies are heterogeneous in terms of design, data quality, data reporting and target population. However, the main conclusion that can be drawn is that there are no apparent differences in effect for the different diets, and both Diabetes UK and the ADA now recommend that a variety of strategies are suitable for promoting weight loss in people with diabetes (ADA, 2008; Dyson et al, 2011).

Low-fat diets

Low-fat diets have long been regarded as the conventional treatment for weight loss in people with type 2 diabetes, due to the fact that fat is a more concentrated source of energy than protein or carbohydrate and that low-fat diets are associated with a reduction in risk of coronary heart disease.

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1. There are few head-to-head randomised controlled trials evaluating different dietary approaches in people with type 2 diabetes, making it difficult to draw conclusions about the most effective dietary intervention for the clinical management of diabetes.
2. Despite a large body of literature comparing weight loss strategies in people without diabetes, there are few comparator studies in people with type 2 diabetes.
3. Diabetes UK and the American Diabetes Association now recommend that a variety of strategies are suitable for promoting weight loss in people with diabetes.

Table 1. Weight loss by various dietary strategies in people with type 2 diabetes.

Type of dietary strategy	Description	n	Mean weight loss (kg)	Comments
Low fat diet (Look AHEAD Research Group and Wing, 2010)	Intensive lifestyle programme using low-fat diet, meal replacements, physical activity and behavioural strategies versus standard care	5154	8.6 (1 year)	6.2 kg (weight loss after 4 years)
Low carbohydrate diet (Kirk et al, 2008)	Meta-analysis of 13 studies	139	4.8	Weight loss associated with degree of carbohydrate restriction.
Low glycaemic index diet	–	–	–	No published information about weight loss in type 2 diabetes.
Mediterranean diet (Elhayany et al, 2010)	12-month RCT comparing low-fat, TM and LCM diet	259	7.4 (TM) 10.1 (LCM)	
Very low calorie liquid diet (Norris et al, 2005)	Meta-analysis of two studies	126	7.7	
Meal replacements (Heymsfield et al, 2003)	Meta-analysis of six studies	472	6.22	Only 20% of participants had diabetes.
Commercial programmes	–	–	–	No published information about weight loss in type 2 diabetes.

LCM=low carbohydrate Mediterranean diet; TM=traditional Mediterranean diet; RCT=randomised controlled trial.

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1. Low-fat diets are often referred to as “healthy eating” and are characterised by: a total fat intake of <30–35% total energy intake; a saturated fat intake of <10% total energy intake; a reduced intake of sugar and salt; and a higher intake of fruit and vegetables.
2. Results from a large US trial, Look AHEAD (Action for Health in Diabetes), suggest that intensive lifestyle intervention, which includes a conventional low-fat diet (30% energy from fat), together with increased physical activity, use of meal replacements and behavioural approaches, can maintain significant weight reductions over 4 years compared with a group receiving standard care (6.15% versus 0.88%; $P \geq 0.01$).
3. Using low carbohydrate diets in practice can be challenging as there is no agreed definition for the term “low carbohydrate”.
4. Low glycaemic index diets are based on foods that have been shown experimentally to lead to lower post-prandial levels of blood glucose and insulin, and include pasta, pulses, oats, multigrain cereals, apples, pears, citrus and stone fruits, and milk products.

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Until recently, the majority of published studies used this healthy eating approach, and the evidence supported its use for weight loss in people with diabetes (Franz et al, 2010). Results from a large US trial, Look AHEAD (Action for Health in Diabetes), suggest that intensive lifestyle intervention, which includes this conventional low-fat diet (30% energy from fat), together with increased physical activity, use of meal replacements and behavioural approaches, can maintain significant weight reductions over 4 years compared with a group receiving standard care (6.15% versus 0.88%; $P \geq 0.01$) (Look AHEAD Research Group and Wing, 2010).

Low carbohydrate diets

Low carbohydrate diets have generated much interest over the past few years following evidence of benefit from randomised controlled trials in people without diabetes. Two reviews have concluded that low carbohydrate diets were effective for short-term weight reduction in people with type 2 diabetes (Dyson, 2008; Kirk et al, 2008). However, most of these studies lacked a control group and little is known about the long-term effects of these diets.

Using low carbohydrate diets in practice can be challenging as there is no agreed definition for the term “low carbohydrate”; the ADA defines it as <130 g/day (ADA, 2008), very low carbohydrate ketogenic diets have been defined as <50 g/day (Adam-Perrot et al, 2006), and a review recommends that diets providing <26% energy as carbohydrate should be termed low carbohydrate (Accurso et al, 2008).

Low glycaemic index diets

A Cochrane review of the effect low glycaemic index (GI) diets in people without diabetes has concluded that they are effective for weight loss, with weighted mean difference (WMD) reported as -1.1 kg (confidence interval [CI] -2.0 to 0.2;

$P \leq 0.05$) (Thomas et al, 2007). However, although a review in people with diabetes reports that low GI diets have a significant effect on glycaemic control, there is no evidence for weight loss (Thomas and Elliott, 2009). Low GI diets are based on foods that have been shown experimentally to lead to lower post-prandial levels of blood glucose and insulin, and include pasta, pulses, oats, multigrain cereals, apples, pears, citrus and stone fruits, and milk products.

Mediterranean diets

Mediterranean diets are typified by higher intakes of: vegetables; legumes; fruit and nuts; cereals; fish and seafood; olive oil; moderate alcohol intake; and lower intakes of meat, meat products and dairy products. Mediterranean-style diets have been shown to reduce the risk of type 2 diabetes, with a 12% reduction in those who adopt all elements of the diet (InterAct Consortium, 2011).

There are few randomised controlled studies of the effect of Mediterranean diets on weight loss in people with type 2 diabetes, although one small study has shown a significant mean weight loss of 7.4 kg over 1 year with a traditional Mediterranean diet, increasing to 10.1 kg for participants adopting a low carbohydrate Mediterranean diet (Elhany et al, 2010).

Very low calorie liquid diets

VLCLDs have been defined by NICE as those providing <1000 kcal/day (NICE, 2006), although the National Obesity Forum (NOF) has a more stringent definition of 450–800 kcal/day (NOF, 2010). VLCLDs consist of liquid foods, often as proprietary formulae, that provide the sole source of nutrition and include a full complement of vitamins, minerals, electrolytes and fatty acids.

A Cochrane review has shown that use of VLCLDs produce a mean weight loss of 7.7 kg, and although this strategy has a significant effect on weight loss in people with diabetes, there is no significant difference compared with conventional low-calorie diets (Norris et al, 2005). A recent small trial in 11 people with type 2 diabetes has created much interest, showing that a VLCLD providing 600 kcal/day resulted in mean weight losses of 15.3 kg over 8 weeks and completely normalised beta-cell

function and hepatic insulin sensitivity (Lim et al, 2011). The trial authors conclude that people with newly diagnosed type 2 diabetes should be informed that they have a potentially reversible condition, and that this can be achieved by means of a VLCLD.

Meal replacements

Meal replacements (MRs) are increasingly being used in weight management programmes for people with type 2 diabetes. Commercially available MRs include milkshakes, bars, soups or entire meals and are usually substituted for one or two meals daily.

A meta-analysis has reported mean weight losses of 7.34 kg with MRs at 3 months, and while only 20% of the participants had diabetes, there were no significant differences between those with and without diabetes. However, at 1 year’s follow-up there were differences, with a degree of weight gain and more attrition reported in those with diabetes (Heymsfield et al, 2003).

MRs have been used in multi-component lifestyle programmes and were included as a strategy in the Look AHEAD trial, where it was reported that the greater the reliance on MRs the greater the likelihood of participants achieving weight loss (Wadden et al, 2011). In addition, the Why WAIT (Weight Achievement and Intensive Therapy) trial has shown average weight losses of 8.2 kg after 1 year’s follow-up of an intensive

lifestyle programme including MR (Hamdy and Carver, 2008).

Commercial weight-loss programmes

There are no published data for weight-loss outcomes in people with diabetes using commercially run programmes, but a recent study comparing different commercial programmes (WeightWatchers, Rosemary Conley and Slimming World) with various NHS initiatives in people without diabetes has reported that all resulted in significant weight loss at the completion of the programme (range 1.37–4.43 kg) although only WeightWatchers was significantly different from the control group at 1 year’s follow-up (Jolly et al, 2011).

Glycaemic control

Although weight loss is associated with improvements in glycaemic control, a Cochrane review published in 2005 stated that changes in HbA_{1c} level were related to changes in weight but were not significant when between-group differences were examined (Norris et al, 2005). However, more recent randomised controlled trials have shown significant improvements in glycaemic control associated with weight loss over both the short- and long-term (Coppell et al, 2010; Look AHEAD Research Group and Wing, 2010; Andrews et al, 2011). This somewhat contradictory evidence may be due to the different determinants

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1. A meta-analysis has reported mean weight losses of 7.34 kg with meal replacements at 3 months, and while only 20% of the participants had diabetes, there were no significant differences between those with and without diabetes. However, at 1 year’s follow-up there were differences, with a degree of weight gain and more attrition reported in those with diabetes.
2. There are no published data for weight loss outcomes in people with diabetes using commercially run programmes, but a recent study comparing different commercial programmes (WeightWatchers, Rosemary Conley and Slimming World) with various NHS initiatives in people without diabetes has reported that all resulted in significant weight loss at the completion of the programme.
3. Weight loss is associated with improvements in glycaemic control.

Table 2. Weight loss strategies and glycaemic control: Summary of recent randomised controlled trials.

Study	Type of diet	Length of study (months)	n	Change in HbA _{1c} level (mmol/mol [%])
Davis et al (2009)	LC versus LF	12	105	-0.2 [-0.02] versus 2.6 [0.24]
Iqbal et al (2010)	LC versus LF	24	144	-1.1 [-0.1] versus 2.2 [0.2]
Ben-Avraham et al (2009)	LC versus M versus LF	24	322	-9.8 [-0.9] versus -5.5 [-0.5] versus -4.4 [-0.4]
Elhayany et al (2010)	LCM versus M versus LF	12	259	-21.9 [-2.0] versus -19.7 [-1.8] versus -17.5 [-1.6]
Larsen et al (2011)	MCHP versus HPLC	12	108	-2.5 [-0.23] versus -3.1 [-0.28]

LC=low carbohydrate; LF=low fat; M=Mediterranean; LCM=low carbohydrate Mediterranean; MCHP=medium carbohydrate high protein; HPLC=high protein low carbohydrate.

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1. Studies have shown that weight loss reduces cardiovascular risk in people with type 2 diabetes by reducing total and LDL-cholesterol and triglyceride levels, increasing HDL-cholesterol levels and reducing blood pressure.
2. Significant and sustained weight loss has long-lasting benefits for blood pressure, especially when weight loss is part of an integrated lifestyle approach.
3. Physical activity is effective in reducing HbA_{1c} levels in people with type 2 diabetes, with a recent Cochrane review reporting a mean weighted reduction of 0.6 percentage points (6.6 mmol/mol) in physically active individuals.

of hyperglycaemia in type 2 diabetes, with positive results associated with a shorter duration of diabetes where insulin resistance is the dominant factor, and less evidence of effect at later stages where insulin deficiency is the key feature (Franz et al, 2010).

There are few published head-to-head trials showing effects of different weight loss strategies in terms of glycaemic control *Table 2* summarises recent available evidence.

Cardiovascular risk

Studies have shown that weight loss reduces cardiovascular risk in people with type 2 diabetes by reducing total and LDL-cholesterol and triglyceride levels, increasing HDL-cholesterol levels and reducing blood pressure (Dyson et al, 2011). Significant and sustained weight loss has long-lasting benefits for blood pressure, especially when weight loss is part of an integrated lifestyle approach (Feldstein et al, 2008).

The long-term effects of lifestyle interventions promoting weight loss in people with type 2 diabetes is under study in the Look-AHEAD trial, which is designed to assess the effect on cardiovascular outcomes in people with type 2 diabetes followed up for 11.5 years. The 4-year results have been published and show significant improvements in the intervention group compared with control for systolic blood pressure (−5.33 vs −2.97 mmHg; $P<0.001$), diastolic blood pressure (−2.92 vs −2.48 mmHg; $P=0.01$), HDL-cholesterol (+0.09 vs +0.05 mmol/L; $P<0.001$) and triglycerides (−0.29 vs −0.22 mmol/L; $P<0.001$) (Look AHEAD Research Group and Wing, 2010).

Physical activity

Physical activity is effective in reducing HbA_{1c} levels in people with type 2 diabetes, with a Cochrane review reporting a mean weighted reduction of 0.6 percentage points (6.6 mmol/mol) in physically active individuals (Thomas et al, 2006). However, physical activity in isolation is not an effective strategy for weight loss in people with type 2 diabetes (Boulé et al, 2001), and maintenance of weight loss requires at least 60 minutes per day of activity (Colberg et al, 2010). Evidence shows that a combination of diet and physical activity results in greater weight reduction than diet or physical activity alone

(Norris et al, 2005), and physical activity does have positive effects on cardiovascular risk and leads to significant reductions in diastolic blood pressure and triglycerides (Shaw et al, 2006).

Conclusion

Lifestyle interventions are effective for weight loss, improving glycaemic control and reducing cardiovascular risk in people with type 2 diabetes, although there is no evidence for the most effective dietary strategy. Outside of pharmacological and surgical interventions, a combination of diet and physical activity is the conventional and most successful route to achieving weight loss, but perhaps the choice of diet should be left to the individual. ■

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