

# Very-low calorie diets: A review of the evidence

By Dr Luke Bereznicki,

## Introduction

Overweight (Body Mass Index [BMI]  $\geq 25\text{kg/m}^2$ ) and obesity (BMI  $\geq 30\text{kg/m}^2$ ) is associated with impaired function of many organ systems, serious medical conditions and a reduced lifespan.<sup>1,3</sup> A recent Australian report found that seven out of 10 men and six out of every 10 women aged between 45 and 64 years are overweight or obese.<sup>4</sup> Even modest weight loss (5% to 10% of body weight) improves multiple metabolic risk factors for diseases associated with obesity.<sup>5</sup> Calorie intake is an important determinant of health. Caloric restriction in adult men and women results in beneficial metabolic, hormonal and functional changes.<sup>6</sup> There has been increasing interest in the therapeutic use of caloric restriction to obtain optimal health and increase life span because caloric restriction has been shown to increase maximal life span in other species.<sup>7</sup> Bariatric surgery-induced caloric restriction, which results in sustained weight loss and improves obesity-related medical conditions, can decrease mortality in extremely obese patients.<sup>8,9</sup> Removing large amounts of adipose tissue by liposuction does not improve insulin sensitivity or other metabolic risk factors for cardiovascular disease.<sup>10</sup> Therefore, caloric restriction is the cornerstone of obesity management. However, there is controversy about the best method to achieve a negative energy balance through caloric

restriction. There are concerns that overly restricted eating is unsustainable, and may even be counter-productive for long-term loss.<sup>11</sup> This article will focus the use of very low calorie diets (VLCDs) to achieve initial and sustained weight loss and associated metabolic benefits.

## Caloric restriction and the role of VLCDs

Total meal replacement involves the replacement of all meals with either a VLCD, containing less than 3350kJ (800 kcal) per day, or a low calorie diet (LCD), which provides between 3350 and 6280kJ (800 to 1500 kcal) per day in energy. Partial meal replacements, as the name implies, are used to replace some, rather than all meals, or used in combination with pre-prepared meals. Partial meal replacements contain a minimum of 12g protein, 850kJ of energy and 25% of the recommended daily intake of a list of vitamins and minerals prescribed by Food Standards Australia and New Zealand. Pre-prepared meals are energy controlled and nutritionally balanced, and may be used as a total or partial substitute for ad lib eating. VLCDs are generally used as the sole source of nutrition, although they can be used as a part of a partial meal replacement strategy (replacing 1-2 meals per day).

When a VLCD form of meal replacement is used to replace all meals, its use should be medically supervised. VLCDs

Table 1. Characteristics of commercially available VLCD products in Australia.<sup>a</sup> Modified from Egger, 2006.<sup>18</sup>

	<b>Optifast VLCD (Nestlé Nutrition)</b>	<b>Optislim 2000 (OptiPharm)</b>	<b>KicStart VLCD (Pharmacy Health Solutions)</b>
<b>Availability</b>	Pharmacies	Pharmacies and health food shops	Pharmacies
<b>Presentation</b>	21-sachet box	21-sachet box	24-sachet box
<b>Alternative presentations</b>	Yes (bars, soups and desserts)	No	No
<b>Price per meal to patient<sup>b</sup></b>	\$2.14	\$2.38	\$2.91
<b>Protein per serve<sup>c</sup> (g)</b>	17.3	16.1	17.9
<b>Carbohydrate per serve<sup>c</sup> (g)</b>	15	16.0	9.6
<b>Fat per serve<sup>c</sup> (g)</b>	2.3	1.6	2.6
<b>Omega-3 and -6 fatty acids</b>	Not listed	Not listed	Yes
<b>Number of vitamins and minerals</b>	27	Not listed	26
<b>Fibre</b>	Not listed	Not listed	Yes
<b>Total energy of prepared drink (kJ)</b>	638 (water)	653 (water)	588 (water); 884 (skin milk)

a. Characteristics apply to the chocolate variety of each product.

b. Pricing information is based on the recommended retail price of the sachet preparation at the time of writing.

c. Protein, carbohydrate and fat levels are for the dry powder. If directions are to mix with skim milk, levels of protein increase by approximately 7g, carbohydrate by 10g and fat by 0.2g.

VLCD = Very low calorie diet

Table 2. The effect of dietary weight loss interventions in overweight and obese adults. Taken from NHMRC *Clinical Practice Guidelines for the Management of Obesity in Adults, 2003*.<sup>17</sup>

Treatment	Weight loss/gain (kg) over 1-2 years <sup>a</sup>	Weight loss/gain (kg) over > 2 years <sup>a</sup>	Ability to prevent regain?
No treatment <sup>b</sup>	-0.2	+1.9 over 3-6 years	No
Ad lib low-fat diet	-3.9 (-2.3 to -6.1); -4.4%	-2.7 (-3.6 to -1.8) over 3-6 years	Yes, to some degree
Low-calorie diet	-6.7 (-12.2 to +0.4); -6.9%	-1.1 (-4.1 to +2.7) over 4-5 years	No
Very-low calorie diet	-16.3 (-8.6 to -25.6); -14.7% <sup>c</sup>	-4.1 (-7.9 to +1.0) over 3-5 years	Yes, to some degree in some individuals if combined with a lifestyle modification program
	-4.2 (-8.6 to +0.5); -4.0% <sup>d</sup>		
	-11.8 (-9.2 to -14.2); -11.0% <sup>e</sup>		
Partial meal replacements	-5.5 (-3.0 to -7.7); -6.0%	-6.5 (-4.2 to -9.5) over 4-5 years	Yes, based on limited evidence

a. Results expressed as mean weight loss, with range of weight loss in brackets and % weight loss in italics.  
 b. Based on the placebo arms of 31 treatment studies lasting 1-2 years and 8 studies lasting more than 2 years.  
 c. After 4-20 weeks.  
 d. After 1-2 years without diet or behavioural therapy.  
 e. After 1-2 years with diet or behavioural therapy.

(e.g. *Optifast VLCD*, *OptiSlim 2000* and *Kicstart*; Table 1) result in a mild ketosis (which may suppress hunger), and contain only enough protein, carbohydrate and fat to preserve lean body mass, maintain normoglycaemia, and stimulate gall bladder contraction, respectively.<sup>12,13</sup> They also contain the recommended daily allowances of minerals, vitamins, trace elements and essential fatty acids. In addition to the VLCD, the intake of two cups of non-starchy vegetables per day is recommended to provide additional fibre.<sup>14</sup> The treatment duration varies, but is usually eight to 16 weeks.<sup>13</sup> However, sustained beneficial outcomes have been achieved with only 30 days of VLCD.<sup>15</sup> Furthermore, a recent case study was published involving a morbidly obese patient, who was treated successfully with a VLCD program (*Optifast VLCD*) for 12 months under close medical supervision.<sup>16</sup>

Total meal replacement with VLCDs is often effective for patients who have been unsuccessful on other programs and/or who have life-threatening co-morbidities.<sup>17</sup> Suitable candidates for total meal replacement with a VLCD are typically morbidly obese (BMI  $\geq$  40kg/m<sup>2</sup>), although VLCDs are also indicated for the obese, or overweight individuals with co-morbidities. Partial meal replacement involving VLCDs is often used in the re-feeding phase as the patient learns to practise dietary lifestyle changes.

### Advantages and concerns

In the past, there have been several concerns regarding the use of meal replacements. These have included concerns regarding the nutritional balances of some commercially available products; potential rebound weight gain on discontinuing use, when this use is unsupervised; and the fact that they may not teach users good long-term eating habits.<sup>18</sup> However, these issues have been largely overcome by improvements in food technology, better training of health

professionals about weight management, and the provision of meal replacements as a component of weight loss programs supervised by health professionals.

One of the key advantages of VLCDs is that rapid effects in the short term may result in increased motivation to implement long-term lifestyle change.<sup>19</sup> VLCDs are low in carbohydrate, and patients become mildly ketotic, which results in reduced hunger and slows the rate of muscle loss.<sup>14</sup> The convenience of VLCDs has also been found to assist with acceptability and compliance.<sup>19</sup>

### The evidence

The National Health and Medical Research Council endorsed a review of the literature (up to 2001) comparing different methods of caloric restriction for long-term weight loss as a part of its evidence-based guidelines for the management of obesity in 2003 (see Table 2).<sup>17</sup> In summary, this review found that VLCDs produce greater initial weight loss than other forms of caloric restriction (nine to 26 kilograms over four to 20 weeks). Long-term weight loss over one to two years was variable, and success was more likely if behavioural or drug therapy was used as a follow-up. In the long-term (3-5) years, the amount of weight lost was similar to that of people who followed other forms of caloric restriction.

Recent short-term studies (4-8 weeks) of VLCDs further demonstrate that a safe and substantial weight loss is achievable (10kg or greater).<sup>15,20,21</sup> There is a perception with VLCDs that the faster weight is lost, the faster it will be regained. Weight regain tends to be inevitable following a VLCD to some degree (as with the majority of weight loss interventions), but if patients are prepared to follow dietary and exercise advice for long term, they are able to maintain the weight loss. There is currently no consensus in

the literature as to whether a greater caloric deficit at the beginning of a weight loss program predicts a greater weight loss at two years.<sup>22</sup> One review found that VLCDs resulted in significantly greater weight loss initially, and in the long term, than low energy, balanced diets.<sup>22</sup> A 5-year follow-up of small groups of obese patients with type 2 diabetes found that weight loss was slower in the intensive conventional diet and exercise group than in the VLCD group, but better maintained at five years (although weight loss was still apparent in both groups).<sup>23</sup> Interestingly, the initial outcomes of total meal replacement with LCDs and VLCDs do not seem to differ significantly.<sup>24,25</sup> In one recent study<sup>25</sup> a LCD (850kcal, 3558kJ per day) or a VLCD (520kcal, 2177kJ per day) were used for 12 weeks, with significant weight loss occurring in both groups (14.3% versus 15.2% for LCD and VLCD, respectively). Following this initial phase, patients transitioned to weight maintenance and were prescribed an individual structured weight meal plan. After 12, 24, 36 and 48 weeks of weight maintenance, there was no significant differences in the amount of weight regain, although the VLCD group tended to regain more weight over time. It should be noted that in this study, the energy intake obtained from the LCD (3358kJ per day) was very close to the upper limit of the VLCD classification (3350kJ per day).

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Although weight regain may occur post-VLCD, it appears that cardiovascular and metabolic improvements are sustained for at least 12 to 18 months.<sup>15,21</sup> In one study, a 30-day VLCD significantly reduced bodyweight in group of type-2 diabetics (mean 11.7kg), and improved dyslipidaemia, hypertension and glycaemia.<sup>15</sup> This effect was sustained at 18 months follow-up despite the fact that patients used less lipid, blood pressure and glucose lowering medication. Patients using insulin at 18 months had regained weight to pre-diet levels, but still had an improved cardiovascular risk profile compared with before the dietary intervention.

## Adverse effects and monitoring requirements

Adverse effects seen with VLCDs include, but are not limited to constipation, cold intolerance, dry skin, dry mouth, headache, dizziness/orthostatic hypotension, fatigue, menstrual irregularities and hair loss.<sup>12</sup> Other more serious effects include gallstones, increased serum uric acid levels, precipitation of gout and reduced bone mineral density.<sup>16</sup> These effects are generally related to the degree of negative energy balance, and the frequency seems to increase with progressively lower levels of intake.<sup>24</sup>

Related to the aforementioned safety issues with VLCDs is the need for medical monitoring. Any total meal replacement strategy involving VLCDs or LCDs requires medical supervision. Contraindications to VLCDs include: pregnancy or advanced age; history of severe psychological disturbance, alcoholism or drug abuse; presence of porphyria, recent acute coronary syndrome, and severe renal or hepatic impairment.<sup>14</sup> Care should also be taken for patients taking hypoglycaemic agents, as hypoglycaemia may occur without a reduction in medication. It is recommended that liver function, lipid profile, full blood count, iron, electrolytes, creatinine and uric acid measurements should be assessed when beginning a VLCD and six weeks following commencement.<sup>16</sup>

## Summary and role of the pharmacist

A number of studies have compared VLCDs to a variety of energy intakes, demonstrating an initial benefit in weight loss favouring the VLCD.<sup>24,26-28</sup> They also demonstrate that the weight loss gap between diets seems to be lost over time as individuals' weight begins to match their weight maintenance behaviours.<sup>25</sup> While weight loss can be achieved with a variety of diets, maintenance is more difficult. It seems that the method of weight loss may be less important than the lifestyle adopted after weight loss has been realised.<sup>29</sup> However, the initial weight loss achieved with VLCDs may serve to motivate patients to continue to lose weight; therefore, it is important that VLCDs are offered within a supporting service to assist the patient to successfully maintain their initial weight loss. Pharmacists should not provide total meal replacement in the absence of medical supervision. However, they are well placed to advise overweight and obese patients on suitable weight management options, provide VLCDs as a part of a total meal replacement program in collaboration with general practitioners and dieticians, provide partial meal replacements and orlistat to suitable candidates and generally support and promote weight management in the community.

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## References

1. Flegal KM, Graubard BI, Williamson DF, Gail MH. Excess deaths associated with underweight, overweight, and obesity. *JAMA* 2005;293:1861-7.
2. Flegal KM, Graubard BI, Williamson DF, Gail MH. Cause-specific excess deaths associated with underweight, overweight, and obesity. *JAMA* 2007;298:2028-37.
3. Fontaine KR, Redden DT, Wang C, Westfall AO, Allison DB. Years of life lost due to obesity. *JAMA* 2003;289:187-93.
4. Stewart S, Tikellis G, Carrington C, Walker K, O'Dea K. Australia's future 'fat bomb': A report on the long-term consequences of Australia's expanding waistline on cardiovascular disease. Melbourne, Australia: Baker IDI Heart and Diabetes Institute; 2008.
5. Goldstein DJ. Beneficial health effects of modest weight loss. *Int J Obes Relat Metab Disord* 1992;16:397-415.
6. Fontana L, Klein S. Aging, adiposity, and calorie restriction. *JAMA* 2007;297:986-94.
7. Weindruch R, Walford RL. The retardation of aging and disease by dietary restriction. Springfield, Ill: Charles C Thomas; 1988.
8. Christou NV, Sampalis JS, Liberman M, et al. Surgery decreases long-term mortality, morbidity, and health care use in morbidly obese patients. *Ann Surg* 2004;240:416-23.
9. Flum DR, Dellinger EP. Impact of gastric bypass operation on survival: A population-based analysis. *J Am Coll Surg* 2004;199:543-51.
10. Klein S, Fontana L, Young VL, et al. Absence of an effect of liposuction on insulin action and risk factors for coronary heart disease. *NEJM* 2004;350:2549-57.
11. Lowe MR, Foster GD, Kerznerman I, Swain RM, Wadden TA. Restrictive dieting vs. 'Undletting' Effects on eating regulation in obese clinic attenders. *Addict Behav* 2001;26:253-66.
12. Saris WH. Very-low-calorie diets and sustained weight loss. *Obes Res* 2001;9 Suppl 4:295S-301S.
13. Mustajoki P, Pekkarinen T. Very low energy diets in the treatment of obesity. *Obes Rev* 2001;2:61-72.
14. Delbridge E, Proietto J. State of the science: VLED (very low energy diet) for obesity. *Asia Pac J Clin Nutr* 2006; 15 Suppl: 49-54.
15. Jazet IM, de Craen AJ, van Schie EM, Meinders AE. Sustained beneficial metabolic effects 18 months after a 30-day very low calorie diet in severely obese, insulin-treated patients with type 2 diabetes. *Diabetes Res Clin Pract* 2007;77:70-6.
16. Sumlthran P, Proietto J. Safe year-long use of a very-low-calorie diet for the treatment of severe obesity. *Med J Aust* 2008;188:366-8.
17. NHMRC. Clinical practice guidelines for the management of overweight and obesity in adults: Commonwealth of Australia; 2003.
18. Egger G. Are meal replacements an effective clinical tool for weight loss? *MJA* 2006;184:52-3.
19. Noakes M, Foster PR, Keogh JB, Clifton PM. Meal replacements are as effective as structured weight-loss diets for treating obesity in adults with features of metabolic syndrome. *J Nutr* 2004;134:1894-1899.
20. Jazet IM, Pijl H, Frolich M, Schoemaker RC, Meinders AE. Factors predicting the blood glucose lowering effect of a 30-day very low calorie diet in obese type 2 diabetic patients. *Diabet Med* 2005;22:52-5.
21. Dhindsa P, Scott AR, Donnelly R. Metabolic and cardiovascular effects of very-low-calorie diet therapy in obese patients with type 2 diabetes in secondary failure: outcomes after 1 year. *Diabet Med* 2003;20:319-24.
22. Anderson JW, Konz EC, Frederich RC, Wood CL. Long-term weight-loss maintenance: a meta-analysis of us studies. *Am J Clin Nutr* 2001;74:579-84.
23. Palsay RB, Frost J, Harvey P, et al. Five year results of a prospective very low calorie diet or conventional weight loss programme in type 2 diabetes. *J Hum Nutr Diet* 2002;15:121-7.
24. Rossner S, Flaten H. VLCD versus LCD in long-term treatment of obesity. *Int J Obes Relat Metab Disord* 1997;21:22-6.
25. Bailey BW, Jacobsen DJ, Donnelly JE. Weight loss and maintenance outcomes using moderate and severe caloric restriction in an outpatient setting. *Dis Manag* 2008;11:176-80.
26. Rytting KR, Flaten H, Rossner S. Long-term effects of a very low calorie diet (nutrilet) in obesity treatment. A prospective, randomized, comparison between VLCD and a hypocaloric diet+behavior modification and their combination. *Int J Obes Relat Metab Disord* 1997;21:574-9.
27. Wadden TA, Foster GD, Letizia KA. One-year behavioral treatment of obesity: Comparison of moderate and severe caloric restriction and the effects of weight maintenance therapy. *J Consult Clin Psychol* 1994;62:165-71.
28. Wadden TA, Stenberg JA, Letizia KA, Stunkard AJ, Foster GD. Treatment of obesity by very low calorie diet, behavior therapy, and their combination: a five-year perspective. *Int J Obes* 1989;13 Suppl 2:39-46.
29. Wing RR, Hill JO. Successful weight loss maintenance. *Annu Rev Nutr* 2001;21:323-41.

## Questions:

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1. Regarding very low calorie diets (VLCDs), which ONE of the following is CORRECT?
  - a) Should never be used in diabetic patients because of the risk of hypoglycaemia.
  - b) Should never be used in diabetic patients because of the risk of ketoacidosis.
  - c) Are defined as containing < 3350 kJ/day (800 kcal/day).
  - d) Should always be supplemented with fat soluble vitamins.
2. Which ONE of the following statements is INCORRECT?
  - a) VLCDs result in a mild ketosis.
  - b) The initial weight loss associated with VLCDs may be advantageous.
  - c) VLCDs can be recommended and supervised solely by pharmacists.
  - d) The convenience of VLCDs may assist with compliance.
3. Which ONE of the following adverse effects is LEAST likely to be associated with a VLCD?
  - a) Reduced bone mineral density.
  - b) Dry mouth.
  - c) Orthostatic hypotension.
  - d) Steatorrhea.
4. Regarding the weight loss associated with VLCDs, which ONE of the following statements is INCORRECT?
  - a) The long-term results of VLCDs depend largely on the lifestyle changes made by patients.
  - b) VLCDs result in greater weight loss than other forms of caloric restriction in the short-term.
  - c) In the long-term, the degree of weight loss associated with VLCDs is similar to that of other forms of caloric restriction.
  - d) If weight regain occurs post-VLCD, the cardiovascular and metabolic improvements of the initial weight loss are lost.
5. Which ONE of the practice points regarding the use of VLCDs is INCORRECT?
  - a) Caution is required for patients using hypoglycaemic agents as hypoglycaemia may occur without a reduction in medication.
  - b) Adverse effects are generally related to the degree of caloric restriction.
  - c) The degree of caloric restriction predicts a greater weight loss.
  - d) Medical monitoring is required at baseline and periodically while a VLCD is being used.

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