

Effective Diet and Exercise Treatments for Overweight and Recommendations for Intervention

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Abstract

Traditional diet and exercise treatments for obesity have been ineffective in reducing the prevalence of overweight in the population. Treatment outcomes for overweight can be measured in terms of physical parameters (e.g. bodyweight, percentage body fat, body mass index), medical terms (e.g. blood pressure, blood glucose control, blood lipid levels), psychological terms (e.g. eating pathology, self-esteem, mood state) and behavioural terms (e.g. frequency of exercise, eating patterns, self healthcare). Regardless of the specific outcome measures used to define successful treatment, the desired outcome must be maintained for several years to be considered effective. Energy restrictive diets cause significant initial bodyweight loss, but are plagued with high dropout- and relapse-rate. Low-fat diets have met with minimal success for bodyweight control, but nonetheless can significantly lower blood lipid levels. High-protein/low-carbohydrate diets are claimed to be the most effective in reducing bodyweight, but there are no scientific data to support these claims. Persons on these types of diets are also at the greatest risk for metabolic adverse effects. Nondietering approaches and programmes that stress 'health at any size' have not been researched rigorously, but preliminary data show minimal bodyweight loss with significant improvements in psychological state, eating pathology and well-being. Exercise is the only variable that consistently shows effectiveness in physiological, medical, psychological and behavioural outcomes. A treatment programme that has the greatest potential for success, regardless of outcome measure, is a programme that consists of 4 key components. These components are: (i) pre-evaluation, where historical information is gathered and used to set programme goals, objectives and outcome measures; (ii) exercise, wherein enjoyable exercise is encouraged for health, bodyweight control and well being; (iii) a behavioural plan, which is based on patterns of eating and activity that will lead to the desired outcome measures; and (iv) a maintenance plan, that helps the individual develop skills for maintaining newly developed behaviours.

The prevalence of overweight has risen to where the World Health Organization (WHO) has described obesity as a global epidemic.^[1] Consequently, cam-

paigns against obesity have been initiated in response to this epidemic.^[1-3] Diet and/or exercise programming are the key strategies used in these

campaigns, and are the most frequently cited methods for both men and women attempting to lose weight.^[1-4] The primary outcomes for obesity treatment have therefore been related to measures of body size, such as bodyweight loss, decrease in body mass index (BMI), percentage of excess bodyweight, and body fat content.^[5] Secondary outcome measures for treatment of obesity have been related to measures of physiological health, such as blood pressure, glucose control, and blood lipid levels.^[5,6] On the other hand, some professionals have proposed a new paradigm for obesity treatment, where the primary outcome measures for success are related to health behaviours rather than any physical or physiological measure.^[7] Furthermore, successful obesity treatment must also be defined in accordance with maintenance of the desired outcome, where maintenance is defined as 3 to 5 years.^[8]

One can see from this discussion that describing *the* most effective treatment for obesity depends upon how one defines effective. It must also be remembered that there are certain risks associated with the treatment itself. These risks must also be evaluated before making any recommendation for treatment. For example, the medical risks associated with the prescription drug combination fenfluramine-phentermine (fen-phen) have overshadowed its effectiveness for use with any patient.^[9] Similarly, the risks associated with gastric surgery are such that this procedure is recommended only for the severely obese.^[1] Overweight patients do not live in a vacuum, and treatments for overweight are not isolated or independent from the influences of related factors. Exercise, lifestyle changes and nutritious eating are encouraged during and after any type of bodyweight-related therapy. Therefore, when one evaluates the effectiveness of a diet or exercise treatment for overweight, one must recognise that any outcome variable used as criteria for success can be influenced by behavioural factors that may, or may not be, part of the intervention. Keeping all of this in mind, this review will evaluate the effectiveness of diet and exercise interventions for the treatment of overweight, and

make recommendations for what constitutes the components of a successful intervention.

1. Effectiveness of Dietary Regimens

1.1 Very Low-Calorie Diets, Low-Calorie Diets and Reduced Energy Intake

Very low-calorie diets (VLCD) became popular during the 1970s and 1980s and are generally described as having an energy content of ≤ 800 kcal (3.35MJ). The primary outcome measure for VLCD has almost always been some measure of body size. The average 12 to 16-week programme produces a bodyweight loss of 20kg, with a bodyweight regain of 35 to 50% after 1-year follow-up.^[4] The initial weight-loss success seen with the VLCD is followed by a gradual bodyweight regain to the point that VLCD programmes show no more long term success than other forms of treatment.^[10] Individual reports vary in their success claims, and it is difficult to interpret their results because drop-out rates can be as high as 80% in some programmes.^[8] The conventional low-calorie diet (LCD) [1200kcal, 5.02MJ] will produce a bodyweight loss of 8.5kg in about 20 weeks.^[4] Two-thirds of this bodyweight loss is maintained after 1 year, but by 5 years, bodyweight loss is negligible.^[4,11,12] A meta-analysis of 25 years of research using energy-restricted diets showed that the average bodyweight loss for a 15-week VLCD or LCD programme was 11kg with a 35% regain in bodyweight after 1 year.^[13] Thus, it seems VLCD and LCD cause substantial initial bodyweight loss, followed by a gradual bodyweight regain.

Another strategy to promote a reduction in energy intake is to maximise the satiating properties of foods so that satiety is achieved with a minimal energy intake.^[14] Early work with gastric emptying suggested that people choosing an energy-dense mixture of food have an empty stomach sooner, and might, therefore, eat more than people who consume food in a more energy-dilute form.^[15] More recent studies have shown that people tend to consume a constant weight or volume of food, so that

their energy intake is dependent upon the energy-density of their diet.^[16] Renewed interest in appetite control has shown that energy intake, not nutrient composition, determines bodyweight loss in response to low-energy diets.^[17] Although several studies have investigated the effects of dietary fat on bodyweight control, few have addressed the effectiveness of intense sweeteners in reducing energy density for bodyweight control.^[16]

1.2 Low-Fat Diets

Low-fat diets and fat-free foods have become increasingly popular over the past 2 decades. Typically, only about 10 to 15% of the 1200 to 1700kcal (5.02 to 7.11MJ) in these diets comes from fat.^[18] There is great controversy as to whether low-fat diets, in and of themselves, can produce substantial bodyweight loss.^[19-21] The National Institutes of Health has declared that the isocaloric replacement of fat with carbohydrates will reduce the percentage of calories from fat, but will not cause bodyweight loss.^[19] They advise that both dietary fat and dietary carbohydrates will usually need to be reduced to produce the caloric deficit necessary for an acceptable bodyweight loss.^[19] However, it is now known that reducing dietary fat will decrease blood lipid content and reduce the risk of cardiovascular disease in individuals who are overweight, even in the absence of bodyweight loss.^[22] The fact that hyperlipidaemia is associated with obesity suggests that a low-fat diet is efficacious for the overweight patient. If the individual who is overweight desires to lose bodyweight through low-fat dieting they must also consider the balance between fat intake and fat oxidation. In other words, bodyweight loss is best achieved by manipulating the balance between the food quotient and respiratory quotient.^[23-26] Research over the past several years has demonstrated that carbohydrate oxidation is directly related to carbohydrate intake, but that an increase in dietary fat does not increase fat oxidation.^[24-26] Thus, a low-fat diet will help shift the balance between fat intake and oxidation toward fat oxidation. It is also known that low-intensity aerobic exercise promotes a greater fat ox-

idation than high-intensity exercise,^[27] and that one adaptation to endurance exercise training is a preferential shift in substrate oxidation.^[28] Therefore, a low-fat diet in combination with low-intensity aerobic exercise will reduce energy intake and promote fat oxidation in the individual who is overweight.

1.3 High-Protein/Low-Carbohydrate Diets

High-protein/low-carbohydrate diets, such as the Atkins diet,^[29] first became popular in the late 1960s and early 1970s, and have resurfaced during the past few years. The high protein and fat content of these diets are claimed to prevent muscle catabolism and to cause a ketogenic state, which suppresses appetite. The carbohydrate restriction produces a rapid bodyweight loss initially, because of glycogen depletion and diuresis; however, the bodyweight is regained when patients are reintroduced to carbohydrates.^[29] There is no scientific evidence to suggest that bodyweight lost through these high-protein/low-carbohydrate diets is maintained. Some adverse effects of the high-protein/low-carbohydrate diets are nausea and hyperuricaemia, which are associated with ketosis.^[29] Fatigue, caused by depleted glycogen stores, is also associated with these type of diets.^[29] Other health risks associated with any type of low-carbohydrate diet include increased risk of heart disease and cancer, elevated blood pressure, gout, kidney stones and osteoporosis.^[29] The fact that the fat content of these diets is 50 to 75% of caloric value, suggests that high-protein/low-carbohydrate diets are more hazardous than beneficial to the health of an individual who is overweight. A modification of the high-protein/low-carbohydrate diets discussed above, which may promote bodyweight loss without health risks, is a high-protein/reduced-fat diet. With a 25:45:30 protein-to-carbohydrate-to-fat ratio, this type of diet produced a bodyweight loss of 8.9kg in individuals who were overweight and consumed \approx 9 MJ/day of energy during a 6-month trial.^[30] Free fatty acids in plasma decreased by 30%, while plasma triglycerides dropped by 0.37 mmol/L during the high-protein diet.^[30] Although no long term

data are available, this form of high-protein/reduced-fat diet may allow individuals who are overweight freedom to choose more lean meat and dairy products while adhering to low-fat diets in bodyweight reduction programmes.^[30]

1.4 Nondietering Approaches

The apparent ineffectiveness of diet and exercise programming to reduce the prevalence of obesity has caused both professionals and consumers to propose an alternative approach to obesity treatment – the health-at-any-size paradigm.^[7] Proponents of the health-at-any-size paradigm believe that restrictive dieting contributes to abnormal eating behaviours, and that once diet restrictions are removed, the individual will develop healthier eating patterns which lead to a genetically-determined healthy bodyweight.^[7] Thus, all of the health-at-any-size programmes employ a *nondietering* approach to obesity treatment. The limited amount of research data suggest that, after a health-at-any-size programme, eating pathology is diminished, psychological state is improved, quality of life is elevated and healthy behaviours are adopted.^[7] Due to the shift of emphasis toward improving psychological health, rather than losing bodyweight, only a few health-at-any-size studies have examined physiological measures such as bodyweight, body composition, blood pressure, blood lipids and glucose control. Currently, therefore, it cannot be determined whether a nondietering approach, that includes a health-at-any-size philosophy, will ultimately lead to bodyweight loss and improved physical health.^[7]

2. Effectiveness of Exercise

The amount of bodyweight lost through exercise participation is often much less than clinicians or their patients expect. A meta-analysis has shown that the average weekly bodyweight loss through exercise participation is only $0.2 \pm 0.04\text{kg}$.^[13] With this in mind, one can understand how easily an overweight individual can become frustrated with the lack of bodyweight-loss due to exercise, and why drop-out rates after beginning a new exercise

programme are 50% within the first 6 months and 70% within a year.^[31] Indeed, 82% of overweight individuals who were not successful in maintaining bodyweight loss reported that cessation of exercise was a key to their bodyweight regain.^[32] Moreover, clinical trials show that exercise is critical to bodyweight-loss maintenance. An abundance of research has shown that those individuals who continue to exercise post-treatment are able to maintain their treatment-induced bodyweight loss for years. Several reviews have recently been published on exercise and bodyweight control, and all of these conclude that exercise is a big factor in maintaining treatment-induced reduction in bodyweight.^[13,33-38] In fact, it is almost guaranteed that exercise maintains bodyweight loss. It is possible, however, that the diet effect on energy balance can completely offset the exercise effect during a bodyweight-loss attempt. Studies have shown that if individuals are presented with a high-fat diet, following a bout of exercise, they consume more energy than when presented with a low-fat diet.^[39-40] On the other hand, when exercise is followed by an *ad libitum* low-fat diet, a short term negative energy balance is induced.^[39-40] These data suggest that the effectiveness of a physical activity programme on bodyweight loss depends partly on the macronutrient composition of the postexercise diet. Normalisation of bodyweight or body fat content through exercise is not necessary to improve the health of obese individuals with metabolic disorders that are thought to be bodyweight-related. For example, researchers have shown that a 6-month exercise programme consisting of 90-minute exercise sessions 4 to 5 times each week at 55% of maximal aerobic capacity improved metabolic profile of obese women in spite of the fact that these women gained 2.3kg bodyweight and 2.8kg body fat during the same time period.^[22] Other researchers have shown that only 7 days of aerobic exercise improved insulin sensitivity and glucose-stimulated plasma insulin levels in obese women.^[41] It is also well established in the literature that regular exercise participation will improve the health of all people, regardless of size.^[2,3,6,19,22,34,35,42] Furthermore,

there is much literature to show that fitness, not fatness, is the determinant for disease and mortality.^[42-44] Therefore, exercise should be part of any obesity intervention, regardless of whether the primary outcome measures for success are bodyweight-related or health-related.

3. New Perspectives for Diet and Exercise Treatments

Recent findings have encouraged professionals to change their approach when using traditional diet and exercise regimens for obesity treatment. The bodyweight-loss goal for the treatment of overweight has been modified from helping overweight persons achieve an ideal bodyweight to helping them achieve a 5 to 10% reduction in bodyweight.^[45,46] This new perspective on treatment is based upon a review of the bodyweight-loss literature that shows hypertension, glucose control, hyperlipidaemia, depression and self-esteem can be improved with only a 5 to 10% bodyweight loss.^[45] However, bodyweight losses of 5 to 10% of initial bodyweight will not normalise or significantly improve health complications in all overweight individuals.^[45] It is also unknown whether most of the overweight population can achieve and maintain even a 5 to 10% bodyweight reduction. Furthermore, it is not clear whether metabolic improvements associated with a 5 to 10% bodyweight reduction are attributable to bodyweight loss per se, or to the healthier diet and/or exercise behaviours required to induce bodyweight loss.^[45,47-49] Most of the bodyweight-loss methods used by individuals who are overweight are not face-to-face commercial programmes, but low-cost alternatives that are primarily self-administered.^[50] The literature addressing success rates of community programmes, worksite interventions, and home correspondence programmes generally show almost full relapse after a couple of years.^[51] A few studies, however, have documented that individuals who are overweight can successfully lose a substantial amount of bodyweight and maintain that bodyweight loss for several years.^[52-55] These previously overweight people who have been success-

ful at maintaining a reduced bodyweight, credit exercise along with a low-fat, calorie restricted diet as being the keys to reduced bodyweight maintenance.^[52,54] For example, the national Weight Control Registry contains self-reported data from formerly overweight individuals who have successfully maintained their reduced bodyweight for at least 1 year.^[54] Those in the registry who have maintained a minimum bodyweight loss of 13.6kg for an average of 5 years report that their success is due to consuming only 1381 ± 526 kcal/day (5.58 ± 2.2 MJ/day) and expending about 400 kcal/day (1.67 MJ/day) in exercise.^[54] Others who have been successful at reduced bodyweight maintenance similarly state that their success is due to maintaining a restricted diet and regimented exercise programme.^[53]

4. Adverse Effects and Health Risks Associated with Bodyweight-Loss Programmes

One of the reasons why nondieting treatments and health-at-any-size philosophies have recently emerged in the realm of obesity treatment is because restrictive dieting has been accused of causing health problems.^[56-57] Proponents of the nondieting philosophy claim that restrictive dieting is associated with psychological disorders, loss of body protein, dehydration, ketosis, hyperuricaemia, hypoglycaemia, hypokalaemia and anaemia.^[56-57] Yet, much of the data to support these claims come from studies that may not be relevant, such as starvation studies performed on men of average bodyweight, and eating disorder studies conducted on anorectic individuals, or other patients with eating disorders.^[56-58] Additional data to support the claims against restrictive dieting come from studies on VLCD. However, the most recent statement from the National Task Force on the Prevention and Treatment of Obesity states that serious complications with VLCD are unusual when VLCD are used under proper medical supervision.^[58] Even the reduction in metabolism seen with VLCD is eliminated when exercise is part of the bodyweight-loss programme.^[59-60] The WHO

declares that only 2 distinct physiological hazards of restrictive dieting and exercise treatments have emerged from the prospective clinical trials, gallbladder disease and reduced bone density.^[1] However, gallbladder disease and osteoarthritis themselves are comorbidities associated with obesity.^[8]

5. Components for Successful Treatment of Overweight

The National Institutes of Health have found that most of the bodyweight-loss programmes available work short term, but very few can demonstrate long term success.^[8] The National Institutes of Health state, however, that successful treatment of overweight must be defined in terms of maintenance.^[8] Therefore, any recommendation for the treatment of overweight must present some potential for long term success, and this narrows the possibilities considerably. Regardless of whether the desired outcomes from treatment are physiological, emotional, or behavioural there are some key components that present the greatest potential for programme success. These are:

5.1 Pre-Evaluation

Before intervention, the individual's medical history, and behavioural history with regard to bodyweight-loss attempts and restrictive dieting, should be reviewed. This should be done to determine potential problem areas and to identify the appropriate outcome variables for each individual.^[6,47] Determinants of success must be clearly identified while goals and objectives should be realistic.

5.2 Exercise and Activity

Exercise has repeatedly been shown to increase outcome success for variables associated with physiological, emotional and behavioural measures. Even when the philosophical position of the treatment programme varies, exercise is critical to successful maintenance of changes in body composition, emotional state, disordered eating and healthful behaviours.^[6,7,32,35-38,52,53] Formal exercise as well

as increased activity of daily living should be encouraged. The exercise or activity programme should be individualised with a focus on helping the individual become more active through frequent and regular activity that is enjoyable. It must also be remembered that the ability of exercise and activity to induce a negative energy and fat balance depends somewhat on the macronutrient composition of the diet.

5.3 Behavioural Plan

A behavioural plan should be designed according to individual outcome variables desired for each client. Success of the intervention will now depend upon achieving the desired behavioural objectives. The overweight individual should play an integral role in negotiating the behavioural plan.^[61]

5.4 Maintenance Plan

The focus of the maintenance plan should be on maintaining the healthier lifestyle established during intervention. The client should be involved in developing the maintenance plan and feel comfortable with its structure. Persons who report long term maintenance of reduced bodyweight credit their success to constant monitoring of diet and exercise behaviours.^[52-53] Those who report improved eating pathology and enhanced psychological state credit their success to the development of internal direction for monitoring new behaviours.^[7,47,48,61] Thus, behaviour monitoring is critical to the maintenance plan, regardless of whether the success criteria are physiological, emotional or behavioural.

6. Conclusion

The prevalence of obesity and overweight continues to rise throughout the world.^[1] Evaluating treatment effectiveness remains somewhat problematical in that success can be measured in terms of physiological, medical, psychological and behavioural outcomes. Short term results are seen with almost all types of programmes, but long term

maintenance of bodyweight loss is variable. Treatment should focus on developing and maintaining behaviours that will produce the desired outcome measures. A treatment programme that has the greatest potential for success, regardless of outcome measure, is a programme that pre-evaluates each client individually, encourages exercise and active living, sets forth a behavioural plan and provides a specific maintenance plan.

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