

The therapeutics of lifestyle management on obesity

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The global incidence and prevalence of obesity continue to increase, with the fastest rate of increase in the developing world. Obesity is associated with many chronic diseases including type 2 diabetes, cardiovascular disease and some cancers. Weight loss can reduce the risk of developing these diseases and can be achieved by means of surgery, pharmacotherapy and lifestyle interventions. Lifestyle interventions for prevention and treatment of obesity include diet, exercise and psychological interventions. All lifestyle interventions have a modest but significant effect on weight loss, but there is little evidence to indicate that any one intervention is more effective. There is evidence of an additive effect for adjunct therapy, and the combination of diet, exercise and behavioural interventions appears to be most effective for both the prevention and treatment of obesity.

Keywords: dietary intervention, exercise, obesity therapy

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Introduction

Obesity has reached pandemic proportions around the world and now poses one of the greatest public health challenges for the 21st century. One billion of the approximately 6.5 billion people in the world are estimated to be overweight [body mass index (BMI) > 25 kg/m²] and, of these, at least 300 million are obese (BMI > 30 kg/m²) [1]. These numbers are predicted to more than double to 2.3 billion overweight and 700 million obese by 2015 [2]. Different societies and cultures exhibit differences in obesity prevalence; rates range from <5% in rural China, Japan and parts of Africa to >75% in urban Samoa. Obesity is traditionally seen as a disease of affluence; however, developing countries are experiencing the highest rates of increase, especially in urban areas.

In the UK, approximately two-thirds of the adult population of England are either overweight or obese and the prevalence of obesity has increased by nearly 400% since 1980 [3], with little indication of slowing or reversal of this trend. A recent prediction indicates that by 2020 over 40% of adults will be overweight and 35% obese [4], meaning that within 10 years more than three-quarters of the adult population of the UK will be overweight or obese. In addition, the prevalence of overweight and obesity among children is increasing. Currently, approximately 16% of children in the UK are obese, and a further 14% are overweight [3], and this has led to the prediction that today's generation of children may be the first for whom life expectancy falls [5].

Implications of Obesity

Obesity has implications for both the individual and society in general. For the individual, obesity is associated with an

increased risk of mortality, shortening life by an average of 9 years with an estimated 30 000 deaths per year in England alone attributable to obesity [6]. Obesity is also related to increased morbidity and is associated with type 2 diabetes, cardiovascular disease, many cancers, asthma, gallbladder disease, osteoarthritis, chronic back pain and depression [7]. Of these diseases, diabetes is most strongly associated with obesity, and obesity-related diabetes is expected to double to 300 million by 2025, with 75% of this growth taking place in the developing world [8]. In addition, there are psychosocial effects of obesity on the individual including low self-image, low self-confidence, social stigma, reduced mobility and poorer quality of life [9].

Obesity also has a wider cost for society. In the UK, treating obesity and obesity-related conditions costs £500 million/year and if indirect costs are included, it is estimated that the overall cost of obesity rises to £7.4 billion/year [6].

Preventing and Treating Obesity

Preventing and treating obesity have proved challenging, with treatment options including lifestyle strategies (diet and physical activity), behavioural and psychological interventions, pharmaceutical interventions and bariatric surgery. Medical models for the treatment of obesity have led to cynicism about the efficacy of lifestyle interventions, although most authorities accept that lifestyle strategies may be the most effective community-based approach [10]. At present, there is little robust evidence to identify the most effective lifestyle strategies for treatment and prevention of obesity. Long-term metabolic studies, with complete control of food intake and physical activity, could provide useful data, but there are difficulties with resources and recruitment and retention of subjects. There have been numerous clinical trials undertaken over the years to assess the effect of lifestyle interventions on obesity in free-living populations, but there are methodological flaws

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in many of these intervention trials. Trials that take place in free-living populations cannot be blinded and may lead to issues with contamination between intervention and control groups and with concordance and compliance. In addition, many studies have involved small numbers of subjects, lacked a control group, have high attrition rates, short follow-up periods and show small weight changes.

Methods

There are numerous published trials of lifestyle interventions for obesity and as the majority of them have many of the methodological issues mentioned above, it was decided to restrict this review to meta-analyses and systematic reviews of obesity treatment published during the past 10 years. An electronic search was performed using MEDLINE (1999 to December 2009), EMBASE (1999 to December 2009) and the Cochrane Central Register of Controlled Trials (1999 to December 2009) using the search terms obesity, weight loss, diet, exercise, physical activity, lifestyle, meta-analysis and systematic review. A primary analysis investigated the overall efficacy of lifestyle interventions for the treatment of obesity and a secondary analysis investigated the relative efficacy of each different intervention.

Results

A total of nine systematic reviews and meta-analyses were identified, which reported the overall efficacy of lifestyle interventions for the treatment of obesity and these are summarized in Table 1. It has proved impossible to combine the results of the reviews using statistical methods as the studies were heterogeneous in terms of design, data quality, data reporting and target population. Despite this, the majority of the reviews showed a small but significant weight loss following interventions which included diet, physical activity and psychological and behavioural strategies. However, most authors report that it is difficult to draw firm conclusions from the data as the quality of both study design and reporting was variable and there was a great degree of heterogeneity. The majority of these reviews also conclude that further, high-quality research is needed in the area under study.

Interventions for the Prevention and Treatment of Obesity in Children

The pandemic of childhood obesity is of global concern, yet there is little evidence to support effective prevention and treatment [20]. Systematic reviews of prevention strategies have produced contradictory evidence, with two authors reporting within a year of each other that only 18% of studies under review reduced BMI [21], and another that 71% of reviewed trials had a positive effect [22]. This apparent discrepancy was later explained by methodological differences with the analyses, emphasizing the problems associated with reviewing heterogeneous data [23]. There is more robust evidence for the lifestyle treatment of obesity in children and adolescents, showing a small but significant reduction in BMI [18]. There

is no evidence that diet or exercise or behavioural components are the most effective treatment, but reviews suggest that the combination of behavioural approaches and lifestyle interventions improves outcomes [24], that the more components included in the interventions the greater the effect [25] and that family-based behavioural strategies increase weight loss [26].

Interventions for the Prevention and Treatment of Obesity in Adults

A widely held belief is that prevention is better than cure, yet there are few studies that investigate the effects of lifestyle on the prevention of obesity. Systematic reviews [27–29] suggest a small but significant effect of lifestyle, and although the small numbers of studies and heterogeneity prevent pooled analysis, one review states that a combination of diet and exercise was associated with a significant weighted mean difference (WMD) weight change at 2 years of follow-up [–2.56 kg; 95% confidence interval (CI) –3.34 to –1.77 kg] [27]. Many of the subjects included in these studies have risk factors for developing diseases associated with obesity, for example, impaired glucose tolerance, and are already overweight or obese and the aim is prevention of further weight gain rather than obesity prevention *per se*. There is more robust evidence for lifestyle interventions for treating obesity, and Table 1 shows a mean difference in weight loss of 0–5 kg between intervention and control groups. This weight loss, although small, was statistically significant for most reviews and supports the hypothesis that lifestyle interventions are effective in promoting weight loss in adults. However, the question remains: what are the most effective lifestyle interventions for promoting weight loss in the overweight and obese?

The Role of Psychological and Behavioural Interventions

Psychological and behavioural therapies used in the treatment of obesity include behavioural and cognitive behavioural therapy, psycho-dynamic therapy, humanistic therapy and group therapy. A pooled analysis showed that WMD weight change for any individual psychological therapy alone was –2.5 kg (95% CI –1.7 to –3.3 kg) over 1 year, and that the addition of diet and exercise components to the intervention increased the weight loss significantly (WMD –4.9 kg; 95% CI –7.3 to –2.4 kg) [13]. The wide number of psychological interventions adopted in trials prevented a subanalysis to identify the most effective, but behavioural interventions (whether combined with diet and exercise, or not) resulted in significant weight loss. In particular, group therapy has been shown to be more effective than individual counselling [30]. The conclusion that behavioural therapy as an adjunct to dietary advice improves weight loss is supported by other systematic reviews [31,32].

The Role of Physical Activity and Exercise

The causal role of low levels of physical activity in obesity is clear; individuals who have higher levels of activity tend to be less obese [14]. However, the role of increased physical activity or exercise in the treatment of obesity is less certain. The inclusion of a physical activity or exercise programme in

Table 1. Summary of systematic reviews and meta-analyses for lifestyle interventions for weight loss.

Study reference	Subjects and sample size	Intervention	Weight change between groups (kg)	Comments
Norris [11]	22 trials 4659 subject with type 2 diabetes	Diet, exercise and behavioural strategies	-1.7 WMD (95% CI -0.3 to -3.2)	Control groups achieved significant weight loss, minimizing differences
Norris [12]	9 trials 5168 subjects with prediabetes	Diet, exercise and behavioural strategies	Over 1 year: -2.8 WMD (95% CI -1.0 to -4.7) Over 2 years: -2.6 WMD (95% CI -1.9 to -3.3)	—
Shaw [13]	36 trials 3495 subjects	Psychological and behavioural strategies	Behaviour therapy alone: -2.5 WMD (95% CI -1.7 to -3.3) Combined with diet and exercise: -4.9 WMD (95% CI -7.3 to -2.4)	Heterogeneous studies prevent conclusions about the most efficacious approach
Shaw [14]	43 trials 3476 subjects	Increased physical activity and exercise programmes	-1.0 WMD (95% CI -1.3 to -0.7)	—
Thomas [15]	6 trials 202 subjects	Low glycaemic index or low glycaemic load diet	-1.09 WMD (95% CI -1.99 to -0.18)	—
Amorin Adegboye [16]	6 trials 245 women after childbirth	Diet and exercise	Exercise alone: 0 WMD (95% CI 8.63 to -8.63) Diet alone: -1.7 WMD (95% CI -2.08 to -1.32) Diet and exercise: -2.89 WMD (95% CI -4.83 to -0.95)	Small numbers, heterogeneous sample
Navaneethan [17]	13 trials in subjects with chronic lung disease	Non-surgical interventions	-3.67 WMD (95% CI -6.56 to -0.78)	—
Oude Luttikhuis [18]	54 trials 3806 children aged <18 years	Diet, physical activity and behavioural therapy	<12 years: At 6 months: -0.06 WMD (95% CI -0.12 to -0.01) At 12 months: 0.04 WMD (95% CI -0.12 to -0.04) >12 years: At 6 months: -0.14 WMD (95% CI -0.17 to -0.12) At 12 months: -0.14 WMD (95% CI -0.18 to -0.10)	Limited quality data in children
Witham [19]	9 trials 1954 subjects aged >60 years	Diet and physical activity	At 12 months: -3.0 WMD (95% CI -5.1 to -0.9)	—

WMD, weighted mean difference; CI, confidence interval.

lifestyle interventions to treat obesity appears to improve rates of weight loss, but exercise alone has only a moderate effect and the effect is enhanced by the addition of a dietary component [14,16,27,33]. There are few data investigating the effects of different types and intensity of physical activity and exercise, and firm recommendations about the relative benefits of aerobic or resistance exercise cannot be made. There is limited evidence showing that more intensive exercise results in greater weight loss (WMD -1.5 kg; 95% CI -2.3 to -0.7 kg) [14].

The Role of Diet

Dietary interventions for obesity treatment have been widely researched and reported, but many studies have methodological flaws, and drawing firm conclusions for clinical practice is challenging. Dietary interventions have small but significant

effects on body weight [11,12], but there is little evidence from randomized controlled trials to identify the most effective diet. Many strategies have been applied in dietary intervention studies and these are discussed below.

Low Fat Diets. These diets are often categorized as 'healthy eating' and are designed to reduce both energy and fat intake while promoting whole grains and fruit and vegetables. Most authorities promote this diet for health and prevention and treatment of obesity [34], and this approach is the most widely used in randomized controlled trials, especially those treating and preventing type 2 diabetes [11,12]. Although this approach has shown a significant, positive effect on weight loss, there is little evidence to suggest it is more effective than other dietary strategies.

Low Glycaemic Index Diets. Low glycaemic index diets contain carbohydrates that are digested and absorbed more slowly and are claimed to increase satiety. A systematic review has shown that diets of low glycaemic index or low glycaemic load have a small but more significant effect on weight loss than comparison diets (WMD -1.09 kg; 95% CI -1.99 to -0.18 kg) [15].

Low Carbohydrate Diets. Low carbohydrate diets, of which the Atkins diet is probably the most well known, have enjoyed a resurgence in popularity for weight loss. It has been shown that the main mode of action of low carbohydrate diets is simply a reduction in energy intake as a result of carbohydrate restriction [35]. Systematic reviews have reported that although these diets may be more effective than comparison diets over the short term, there are no differences in weight loss beyond 6 months of follow-up [36,37]. Concern has been expressed about the potential adverse effects of these diets, especially on cardiovascular risk, but there remains no evidence of harm over the short term [37].

Mediterranean Diets. Mediterranean diets are characterized by high intakes of olive oil, fruit and vegetables, pulses and low intakes of saturated fat. Epidemiological data have suggested that those eating a Mediterranean diet are less prone to obesity and that adopting this dietary approach may reduce body weight [38]. A small review reported that Mediterranean diets were as effective as low fat diets for weight loss [39] and they are reported to have positive effects upon cardiovascular risk, independent of weight loss [40,41].

Meal Replacements. Meal replacements consist of liquid shakes, soups or bars designed to be eaten in place of one or two meals daily. A meta-analysis reported that partial meal replacements produced greater weight loss than a reduced energy diet, with a random effects analysis showing greater weight loss at 3 (2.54 kg) and 6 months (2.63 kg) [42].

Very Low Calorie Diets. Very low calorie diets (VLCD) typically provide <800 kcal/day and are often taken in liquid form (VLCLD). Compared with low calorie diets (LCD), VLCD show greater losses in the short term (16.1 vs. 9.7 kg) but similar weight losses over the long term (6.3 vs. 5.0 kg) [43]. There is a suggestion that VLCD may be more effective than other strategies for weight loss in people with type 2 diabetes [11].

Commercial Weight Loss Programmes. Commercial weight loss programmes use a variety of interventions including group therapy, dietary advice and exercise. Weight loss and attrition rates for these programmes are not widely available and rely upon anecdotal evidence.

The gold standard, the randomized controlled trial, is rarely used to compare different commercial diets head-to-head. Three studies have been published and details of these are shown in Table 2. In these three studies, a total of seven different dietary strategies were used, and in all cases showed a significant reduction in weight compared to baseline regardless of the dietary intervention [44–46]. In addition, there were no significant differences in weight losses between the groups, with the exception of one trial that reported a significantly

Table 2. Summary of head-to-head randomized controlled trials comparing dietary strategies for weight loss.

Study reference	Subjects and sample size	Length of study (months)	Weight loss by intervention (kg) Mean (s.d.) unless otherwise stated						
			Atkins	Ornish	Weight watchers	Zone	Slim-Fast	Rosemary Conley	LEARN
Dansinger [44]	160 obese adults (BMI 35)	12	2.1 (4.8)	3.3 (7.3)	3.0 (4.9)	3.2 (6.0)	—	—	—
Truby [46]	293 obese adults (BMI 32)	6	6.0 (6.4)	—	6.6 (5.4)	—	4.8 (5.6)	6.3 (6.1)	—
Gardner [45]	311 premenopausal women (BMI 32)	12	WMD 4.7 (95% CI: 6.3–3.1)	WMD 2.2 (95% CI: 3.6–0.8)	—	WMD 1.6 (95% CI: 2.8–0.4)	—	—	WMD 2.6 (95% CI: 3.8–1.3)

WMD, weighted mean difference; CI, confidence interval; Atkins, very low carbohydrate diet (<20 g/day); Ornish, very low fat diet ($<10\%$ fat); Weightwatchers, commercial group programme; Zone, 40% carbohydrate/30% protein/30% fat; Slim-Fast, liquid meal replacements; Rosemary Conley, low fat, high fibre diet + exercise; LEARN, behavioural approach to weight control.

greater weight loss with the Atkins diet compared to the Zone diet [45].

There is some evidence from systematic reviews that support the observation that long-term effects of different diets on weight loss are similar. Although the majority of evidence supports the use of low fat diets, there is little evidence for other strategies over the longer term [47]. Low carbohydrate diets and VLCD have been shown to induce greater weight loss initially, but the differences disappear by 2 years and beyond [48]. In terms of dietary strategies for weight loss, encouraging the individuals to adopt their diet of choice may well improve outcomes as weight loss occurs with all diets, it is the degree of adherence that will predict outcomes [49]. It is intuitive that a diet that an individual enjoys and finds acceptable is more likely to succeed [50].

Effect of Lifestyle Interventions Upon Risk Factors

The aim of weight loss for the overweight and obese is to improve the quality of life and reduce the risk of the diseases associated with obesity. The strongest evidence for the protective effect of lifestyle interventions is for type 2 diabetes, where weight loss is the most effective component for prevention [51] and treatment [52]. Intentional weight loss has been shown to prevent and improve risk factors for cardiovascular disease [53] and although there is little evidence for weight reduction and stroke [54], asthma [55] or cancer [7], it is important to note that these results relate to a lack of evidence and not that weight loss is not effective in reducing risk.

Conclusions

All lifestyle interventions have a modest, but significant, effect on weight loss in the overweight and obese. There is no evidence that one individual component of lifestyle interventions, whether it is dietary, exercise-based or behavioural, is more effective than another. Exercise alone shows a moderate effect, but is more effective when combined with dietary interventions. Behavioural therapy is an effective adjunct to diet and exercise. In addition, group approaches are more successful than individual counselling and family-based psychological interventions are effective in children. There appears to be an additive effect of these individual components, with multi-component interventions reporting greater weight loss. There is no evidence that any one dietary strategy is more effective than any other, and encouraging each individual to adopt a diet they find acceptable may increase weight loss.

Conflict of Interest

All contributions are by a single author including data collection, analysis and preparation of the manuscript. No competing interests to declare.

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